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CARBON.

The communication by Prof. Stine, which will be found on another page of this issue, brings out several points relating to arc lamps and arc light carbons which should be carefully considered by American manufacturers. We fail to find any good reason why arc light and battery carbons should not be produced in this country equal in quality and as cheap in price as the imported article. There is a large field open for such a production which promises splendid remuneration to the successful occupant. The arc lamp itself remains in a crude and unsatisfactory state, and in fact there is no branch of applied electrics which has remained so near fundamental conceptions as existing arc lighting systems. That there has been some growth is not denied, but such has not been in keeping with that attained by both direct and alternating-current systems of incandescent lighting. Although the arc lamp for street lighting is not likely to be soon superseded, even though it remains in its present stage of development, this is not a sufficient reason for assuming that improvements are unnecessary.

THE TROLLEY PATENT SITUATION.

Of recent years it has become a debatable question whether or not patents containing such sweeping claims as those of the polyphase system or the underrunning trolley will stand the ordeal of a test case in the courts. Modern adjudication of such matters has tended strongly against the patentee, and favorable decisions which enable the owners of the patents to become powerfully aggressive are not given, unless the most convincing and unshaken testimony be submitted. Even slight technicalities will alter the decision. Particularly is this the case when the alleged infringer has produced a device that is better than the original. In deciding against such a defendant, a judge must not only be convinced by his own sense of justice, but must also withstand the pressure of public opinion, which in such a case is always with the defendant. In the present trolley patent litigation it seems as though the defense had established some very important points of difference which would result in a decision in its favor. In any event the opinion will be most interesting, for it will in a measure decide whether the use of one or more of a number of features classed together as necessary to the device in question can be considered an infringement. Because a party uses bolts, nuts or rivets in the construction of his machine it does not follow that the use of bolts, nuts or rivets are to be forbidden to the maker of a competing apparatus.

MUNICIPAL OWNERSHIP.

The subject of municipal ownership is a doctrine in political economy which, although antedating the days of Adam Smith, has as yet reached but limited proportions under the corporate domain of American institutions. The eager desire apparently manifested on the part of a few municipalities to take upon themselves the control of various forms of industry, has of late years made itself particularly prominent in the unsuccessful operation of electric light plants. Were any evidence wanting to demonstrate the correctness of this statement the papers read before the recent convention of street lighting officials held in New Haven should prove conclusive. Mr. Francisco's paper was unavoidably shortened owing to the difficulties involved in obtaining accurate and reliable data. Sufficient information, however, was presented to demonstrate the fact that a large number of municipalities are

gradually realizing that political partisans lack certain essential qualifications for the successful and economical operation of an electrical supply station. It has been stated that base fabrications may be classified under three headings, simple ordinary lies, ——lies, and statistics. We are not in accord with this distinction, but that statistics should be so designated is to be attributed to one of two causes—either they are founded upon unreliable sources of information or are subjected to incorrect interpretations. There is no doubt as to which category most figures setting forth the operation of municipal electric lighting plants belong, and it is owing to this fact of almost total unreliability that the arguments hitherto presented against municipal control have lacked in force and conclusiveness and that municipalities which have not tried the scheme look upon other attempts as most successful. A few papers such as those presented at New Haven distributed about the country would materially aid in relieving many of this innate desire, avoid additional taxation and at the same time confine their political charlatans to those offices affording the least number of opportunities for political intrigue and financial juggling.

INSULATING MATERIALS.

Materials used for insulating purposes naturally fall under different groups, depending upon their physical and electrical properties and the purposes to which they are to be applied. In testing any material, therefore, the specific conditions under which it is to be subjected should be complied with as nearly as possible. The electrical properties of any material may be determined by tests upon the insulation resistance and high-voltage breaking-down tests, whereas under its physical properties are to be included hydroscopic and limits-of-temperature tests, bending and pressure strains. Such tests are to be looked upon in the same light as those made upon structural materials for the purpose of determining the factor of safety which should be employed when such material is to be used for a given specific purpose. An important supplement to the paper presented before the last annual meeting of the Institute appears in this issue in a communication by Mr. Scott, giving the results of experiments carried out by Mr. Skinner. These experiments conform as nearly as possible to actual commercial conditions and therefore are worthy of careful study. When comparing Mr. Skinner's results with those contained in the Institute paper, it will be noted that the two sets of experiments have in common the characteristic feature of passing through a minimum but at different temperatures, those given in the former paper having a maximum at that temperature found to be a minimum in the latter. This is doubtless to be explained upon the assumption that the moisture which was present in both cases was longer retained by the materials tested by Mr. Skinner. The results show that there is little dependence between the insulation resistance and the breaking-down point of any given material, although those materials having a low-insulation resistance were those which broke down most easily. It would have been interesting if some curves had been given showing the properties of some of the materials after first being subjected to high temperatures and then allowed to cool.

MINERAL PRODUCTS OF THE UNITED STATES.

The recent report of the United States Geological Survey contains some data which is of special interest to manufacturers of electrical apparatus. The report gives the total output and value of the mineral products of the United States for the past 10 years and affords an interesting study of their relative gains and prices from year to year. The following are a few selections directly bearing upon applied electrics. The output of each of the products named reached the maximum last year, with the exception of lead. The production of pig iron in 1895, in long tons, was 9,446,308, having a value of $105,198,550, or $11.13 per ton. The largest previous output was in 1890, being 9,202,703 long tons, valued at $16.43 per ton. The comparison shows a net decrease of $5.30 per ton in five years. During the 10 years covered by the report, excepting the year 1893, the production of copper has steadily increased from 161,235,381 pounds, valued at $16 527,651, in 1886, to 381,106,868 pounds, valued at $38,682,347, in 1895. The price in New York City was, therefore, but 2 cents per pound more in 1886 than in 1895. The total production of lead in the United States in 1886 was 130,629 short tons, representing a value of $12,200,749, or 4.67 cents per pound, and 161,440 short tons in 1895, valued at $10,655,040 or 3.3 cents per pound. The production of zinc for the same period increased from 42.641 short tons, valued at $3,752,408 in 1886 to 89,686 short tons in 1895, valued at $6,278,020. The output of quicksilver in 1895 was 36,104 flasks of 76.5 pounds each, representing a total value of $1.337,131, being an increase in production of 6123 flasks as compared with the year 1885, the value of both periods being practically the same. The figures given for aluminum show the most marked differences, the increase in output during the 10 years being steady. In 1886 the total production amounted to 3000 pounds, valued at $9 per pound, whereas in 1895 it reached 920,000 pounds at a value of but 50 cents per pound. The figures representing the output of bituminous coal show that in 1895 there were mined 135,118,193 short tons, valued at the mines at $115,749,771, or 85 cents per ton, as compared with a production of 73,707,759 short tons in 1886, valued at $1.06 per ton. The output of anthracite coal also showed a marked increase, being 34,853,077 long tons in 1886, valued at $76,119,120 and 51,785,122 long tons in 1895, valued at $82,019,272. The mica production for 1895 is not stated but its value is given as $55,831. The last statement of production was for the year 1893, when the quantity was 65,971 pounds, valued at $88,929. In 1885 the amount mined was 40,000 pounds, representing a value of $70,000. Asbestos reached a total output in 1895 of 795 short tons, at a value of $13,525, or 85 cents per pound, as compared with 200 short tons in 1886, valued at $6,000, or $1.50 per pound.

The Electrical Resistivity of Bismuth.

Prof. J. A. Fleming in a recent communication to the London *Electrician* gives the results of some low-temperature tests made by Prof. Dewar and himself on the resistivity of bismuth. In continuing their experiments in this line, when low temperature in the magnetic fields was produced by the aid of a powerful electromagnet, they observed that a wire of electrolytic bismuth when cooled in air to a temperature of 186 degrees C., has its resistance increased more than 42 times if it is at the same time transversely magnetized in a field of 14,000 units. The bismuth when cooled in liquid air and thus magnetized, has its electrical resistance increased more than 15 times even when compared with its resistance at ordinary temperature and not in a magnetic field. They believe that they have not reached the limits of this increase. The exact figures of the tests are as follows: The wire of electrolytic bismuth had a resistance of 1 46 ohms at 19 degrees C. when not in a magnetic field. When placed transversely to a field having a strength of 14,150 C. G. S. units, its resistance was increased to 2.34 ohms at 19 C., degrees, or 1.6 times. This effect, of course, is well known. When the same wire, however, was placed in liquid air and cooled to 186 degrees C., its resistance fell to .53 of an ohm. Then when placed transversely in a field of 14,150 C. G. S. units, its resistance immediately increased to 22.4 ohms or 42.2 times. Hence, the bismuth cooled to this degree and in a field of such strength has a resistance 15.3 times greater than when at 19 degrees and not in the field. A certain value of the field was found which just neutralizes the diminishing effect of the cooling on the resistance and leaves the wire when cooled in liquid air and in a field of the same resistance the same as when not cooled and not in the field.

The Hungarian Exposition.

BY JOSEPH HERZOG.

The Hungarian nation celebrates the 1000th year of its existence with an imposing exposition in which it shows its development in every direction. Naturally one of the youngest of the acquisitions belonging to this development is that of the electrical industries, almost exclusively represented at this Exposition by the firm of Ganz & Co. The present location is the same as that of 1885, at which time this firm introduced the alternating-current transformer system. The founder of this Hungarian electro-technical industry is the chief manager of this company, Mr. Andreas Mechwart, and it was based on the old iron foundry and machine works at Budapest in 1878.

The following is a brief description of the principal electrical features of the Hungarian Exposition :

The Exposition switchboard is divided into three parts, one of which is utilized by the Ungarische Electricitäts Gesellschaft, employing an alternating-current system with transformer distribution. The second by the Erste Budapester Allgemeine Electricitäts Gesellschaft, employing two-phase alternating-current motors, driving direct-current generators and with accumulator distribution, and the third by Ganz & Co The two former companies supp'y current from their central stations in the city, while Ganz & Co. have erected a complete station on the Exposition grounds.

The distribution of arc lamps was fixed by the Exposition management as follows: For the district of the Ungariches Electricitäts Gesellschaft, 130 arc lamps at 16 amperes ; for the district of the Erste Budapester Allgemeine Electricitäts Gesellschaft, 56 arc lamps at 16 amperes, and for Ganz & Co., 75 arc lamps at 16 amperes. The first company supplies the chief entrance and the Exposition bridge ; the second company another entrance and the river navigation department, and Messrs. Ganz & Co. the lighting of the "Corso" and the Industrial Hall.

The area of the whole Exposition territory consists of 510,000 square metres, of which 87,000 square metres are occupied by the different buildings and 22,000 square metres by water, leaving 1530 square metres for each of the 261 arc lamps ; that is, a lighting diameter of 44 metres for each arc lamp. The total number of lights including the public and private pavilions amounts to 700 arcs and 3600 incandescents, of which the Exposition station supplies 234 arc and 2292 incandescent. This station contains two alternating-current generators of the type A 6½ for lighting purposes, each with an output of 100 kilowatts at 300 volts and 250 revolutions per minute. These generators, which are directly connected to high-speed engines running condensing deliver current to 15 transformer stations. In the same station there are also running two three-phase generators for traction purposes, each with an output of 140 kilowatts at 250 revolutions per minute, both of the type A. F. 6½. One generator is rope-driven by a horizontal steam engine and the other direct-connected to a vertical engine. There are also in use generators for traction purposes, directly-connected with vertical engines. The distribution board is so arranged that one side only is used for lighting, the other being used for traction service. Besides the cables which lead to the chief transformer stations, there is also connected to the switchboard the cable previously mentioned running from the central station of the Ungarische Electricitäts Gesellschaft, and so arranged that it is possible to feed any part of the lighting system or supply alternating currents for traction purposes, either in parallel with the Exposition generators or independently.

There are, all told, 3940 metres of concentric cable carrying alternating currents at 3000 volts, and 11,357 metres of underground lead-covered cables supplying the "Corso" and some of the pavilions. The Exposition management has allowed free competition for electric power to the different exhibitors, and the firm of Ganz & Co. have, all told, 110 motor-generators supplied with three-phase currents and delivering direct currents. Thirty-two direct-current motors of 25 horse-power each run the pumps in the fire-station. Sixty-two motors, ranging from ½ to 20 horse-power, run the large steam engines for Exposition purposes in the printing pavilion and the large machinery hall. Twenty-nine alternating-current motors, ranging from ½ to 16 horse-power in the industrial and other halls, are operating weaving and spinning machines, sewing machines, models of milling and sugar manufactory machines, milk-dairy machines, a saw grate, a complete tobacco factory, a chocolate factory, etc. In the main hall of Ganz & Co. one three-phase motor is running under water, another on springs, while small three-phase alternating and direct current motors of from .01 to ½ horse-power drive fans. On the large pond are running small electric launches, the accumulators of which are charged from rotary transformers supplied by Ganz & Co., who also fitted out the electrical equipment. In the Ganz pavilion there are 73 electrical machines of various kinds, direct three-phase rotary transformers and various motors, the largest of which is 600 horse-power and the smallest .01 of a horse-power. All types of special apparatus are shown, such as boring and shaping machines, pumps, ventilators, planers, etc., operated by direct-connected motors. Further, there are shown completely equipped street cars, an under-running trolley system, the newest types of railway and crane motors with their working parts exposed to view and different details explained. A large model shows a factory producing insulating and fitting materials for electric railway and lighting plants.

The Exposition railway was built by the firm of Roessemann & Kuhnemann with the aid of Ganz & Co., the former firm supplying the cars and the latter the electrical equipment. This railway has a length of 1.3 kilometres (three quarters of a mile) and the maximum speed is 16 kilometres per hour (about 10 miles). From three to four carriages are drawn by a small locomotive of five tons, having two motors of 8 horse-power, each working at 300 volts pressure. The overhead trolley is used. In the middle of the "Corso" stands the Fontaine Lumineuse built by Ganz & Co., which consists of rock seven metres high on which are resting figures representing the "Plattensee" tale of the fairy "Sio."

Light is supplied from 23 arcs at 42 amperes and 300 volts pressure, four being placed in series. The direct-current generators which deliver current to the fountain lights are operated from the Ganz pavilion and directly connected to high-speed engines. There are three generators for this purpose, one having an output of 100 kilowatts at 300 volts and running at 250 revolutions, serving as a reserve for two others which operate in parallel and have a total output of 122 kilowatts at the same pressure and run at 325 revolutions per minute.

The pump plant consists of two Worthington pumps, having a capacity of 6000 metres (1500 gallons) per minute, located in the Exposition boiler room, 500 metres from the fountain. These pumps draw the water from the base of the fountain and drive it through a pipe 400 millimetres (about 16 inches) in diameter, to the distribution pipes beneath the fountain. The outlet pipes running from the basin to the pumps is 500 millimetres (about 20 inches) in diameter, and has five funnels, so constructed that whirlpools are not produced.

Municipal Electrical Association.

The following is a list of the officers elected June 12, for the next meeting of the Municipal Electrical Association to be held in Manchester in 1897.

President, C. H. Wordingham, Manchester; vice-presidents, A. H. McCowen, Belfast, and F. Newington, Edinburgh; committee, Arthur Wright, past president, Brighton; Wm. Arnot, past vice-president, Glasgow; A. H. Gibbings, Bradford; A. B. Mountain, Huddersfield; John H. Rider, Plymouth; T. P. Wilmhurst, Halifax; Hon. treasurer, Mr. G. H. Cottam, Hampstead; Hon. secretary, A. B. Mountain.

It was unanimously resolved to present to Mr. Wm. L. Madgen, who has been acting as honorary secretary during the period of organization and the first convention, the best thanks of the members for the invaluable help he has rendered in the formation and organization of the association, and as a record of their appreciation the resolution is to be suitably engrossed and presented to him with a bronze to be selected by himself.

A Suggestion for a New Kind of Focusing X-Ray Tube.

A French physicist, M. Gouy, in a recent paper, read before the French Academy, showed that when the platinum plate in the usual focus tube is so placed that the emission takes place nearly in the plane of the plate, that is, when viewed nearly edgewise, it becomes a source of very great intrinsic intensity; that is, the source of the rays becomes a small surface of great intensity. Based on this principle, it seems to us that quite a powerful source, whose apparent size is little more than a point, might be made by constructing the cathode in the form of a portion of a cylinder, instead of a sphere, focusing its rays on to a very narrow platinum strip, and then turning the tube until the Röntgen rays are emitted nearly in the plane of this tube, that is, nearly in the direction of the strip; the cathode rays would then be focused on a strip in the form of a line, and that line would be brought to nearly a point, as viewed endwise.

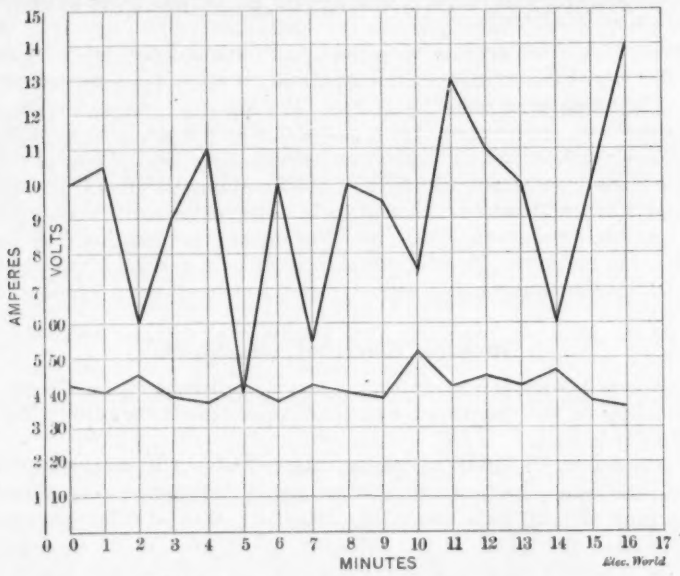
Some Faults in Arc-Lamp Carbons.

BY W. M. STINE.

THERE are some features of applied electrics which seem to remain in a condition of arrested development, and share to but a limited extent in the scientific progress made in so many lines. The reference here made is to the arc lamp, and arc-lamp carbons in particular. Regarding the latter, American consumers are content to import the better grades of carbons, while our own makers seem unable to supply a competing article. These remarks are made not so much in the spirit of condemnation of existing conditions as in the hope that attention may be attracted to needed remedies.

A series of tests recently conducted by the writer may be offered in illustration. It had been noted that a certain make of carbons gave poor service when burned in one type of arc lamp, but were satisfactory when used with a number of other lamps. Those who have had much experience with constant-potential arc lighting know how frequeutly such conditions obtain. In order to arrive at an explanation of the facts the tests given below were carried out. They apply to constant potential service in particular.

The carbons were imported, of medium hardness, $\frac{11}{16}$ inch in diameter and cored for the positives and paired with smaller and solid negatives. The faults developed in use were the formation on both tips, but especially on the positive, of small globules. In action these seemed to bridge the arcs, thus short-circuiting the carbons and causing them to "stick." When cooled, the globules were found to be of two kinds; some were dark gray, or metallic in appearance,



Test Curve of Arc-Lamp Carbons.

others resembled jet, while all were of such high resistance that a magneto could not be rung through them. The gray globules were of such hardness that they readily scratched glass, and probably consisted in part of silicon carbide. The others seemed to have been formed from residual, uncarbonized pitch. Another peculiarity of these carbons was that the usual white coating was very pronounced, extending to a height of several inches above the positive tip, and in some cases was nearly $\frac{1}{16}$ inch in thickness. The white fumes had in time penetrated the lamp case and fouled the works.

The lamps on which these faults were so apparent were of the differential type, and the carbons actuated by a clutch operated conjointly by the series and shunt-magnets. Aside from the unsteadiness of the carbon feed usually found associated with the clutch feed in constant-potential circuits, the armature to the shunt coil was long and ended in a large mass of laminated iron. The great mass and movement of the armature caused it to act somewhat like a heavy hammer, and being actuated by a magnet sensitive to every change in potential distribution in its own and mated arc, was in constant motion.

Upon first consideration, the faults above noted were attributed to the carbons alone, for it was not so apparent that the lamps were an important factor in producing them. Upon a further investigation it was found that the same carbons were burning with satisfaction in a variety of lamps on similar circuits, developing no unusual faults.

The Tests.—After burning a sufficient number of carbons, to ascertain the frequency with which the faults appeared, readings were taken and plotted as in the figure. Then, in order to further study the lamps, carbons of a variety of grades were burned and the readings plotted for comparison. The curves showed sufficient similarity to indicate that the lamps acted about the same, independent of the quality of the carbons. With harder grades of carbons, no globules nor excessive coating formed. The source of the globules and coating was next sought. Surmising that they came principally from the material in the core, this was bored out. When burned, the coreless carbon, though much lowered in candle-power, showed but a slight coating and no globules formed.

A comparative study of the behavior of the carbons when burned in a different type of lamp was next undertaken. The readings when plotted showed the present lamps were taking about the same average current as the others, but the regulation was more gradual, the extreme peaks of current being noticeably absent. The results obtained were a relatively higher candle-power, but slight coating and entire absence of globular formations. It was considered important to study the carbons when burning with practically constant currents. To effect this the carbons were clamped in a fixed position and fed by hand. The currents employed ranged from 10 to 50 amperes. In all cases the carbons showed nothing abnormal for at a constant temperature due to fixed currents all the products of their combustion vaporized. The grain of the carbon was also tested. This was effected by reducing the carbons by electrolysis, a method already described by the writer. * The grain was found to be very fine and practically uniform throughout. The white deposit on chemical analysis showed no unusual constituents, but was largely composed of silicic oxide. The cooled surface of a burned carbon generally showed the presence of a considerable amount of ferric oxide, though by no means an unusual percentage.

Conclusions.—The opinion seems to be well founded that the faulty behavior of the carbons was not due to unusual defects either in their composition or manufacture, but rather to the poor regulation of the lamps in which they were burned. On starting, these lamps would usually take 20 amperes, while the curve in the figure shows a variation between four and fourteen amperes. Moreover, these variations were both extremely abrupt and frequent. The evidence of the tests just detailed indicated that during the peaks of current, the high temperature drove out the uncarbonized pitch, especially from the core, and that the plastic carbon fused with the silicic and ferric oxide impurities. These were followed by a sudden dropping of the current to very low values, cooling the carbons, preventing these substances from volatilizing, and passing to the edge of the crater they there assumed permanent form. At times, when such globules attained a larger size, they caught the carbons when in near approach and so produced the "sticking" of the arc. When these carbons were burned with a fairly uniform current, the extraneous compounds formed more gradually and were slowly dissipated.

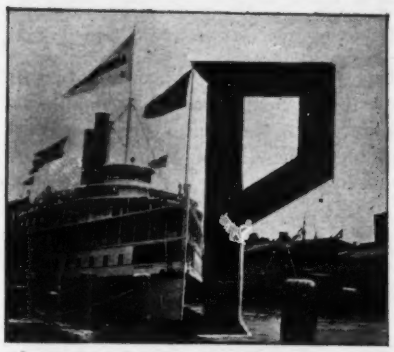
For constant-potential arc lighting it is advisable to use carbons of medium softness for high candle-power, and they must, at least at the present stage of carbon manufacture, be cored.

To those who are constantly testing carbons, it seems that their quality should be greatly improved. Perhaps the manufacturers take a different view, because they do not find improvement either possible or profitable. The ideal carbon should be free from both iron and silicon, and the binding pitch in it should be thoroughly carbonized. The difficulty at present seems to be to prevent the carbons becoming graphitic when so thoroughly carbonized. The difficulty is increased by the use of softer cores, in which a higher percentage of pitch and often alkaline carbonates are employed.

As to the methods of regulation of constant-potential arc lamps, a decided difference of both opinion and practice exists. Some hold that such lamps should be differentially wound, others that only series regulation is efficient. The objection to the use of a shunt coil is that its action is subject to every change in the potential distribution throughout the series of arcs and resistances. The method of feed is perhaps of even greater importance. The feed should be positive, with no retrograde movement except a "take-up" for striking the arc. Any form of clutch which is operated through all the changes of magnetism of the regulating magnet, must inevitably produce a continually changing arc. No manufacturer can produce a carbon for high candle-power that will yield satisfactory results with such mechanism. Only very hard carbons should be used in such lamps, the resulting low candle-power being unavoidable.

* The Electrical World, Feb. 23, 1895; p. 224, Vol. XXVII.

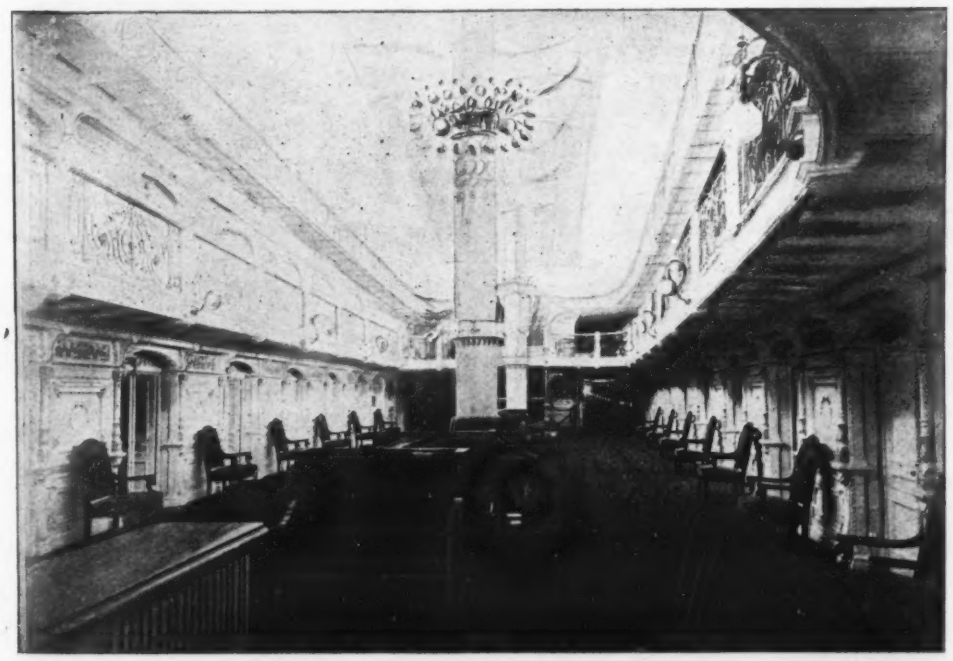
Electric Lighting on the Steamer "Adirondack."



PERHAPS one of the most finely equipped boats that has ever been built for river navigation in the United States is the steamer *Adirondack*, of the People's line, which plies between New York and Albany. No particular pretensions to high speed have been made, but great care has been taken for the comfort of the passengers. Not the least among these comforts is a profuse and well-arranged electrical lighting system, and the plant and equipment are of the most modern current practice.

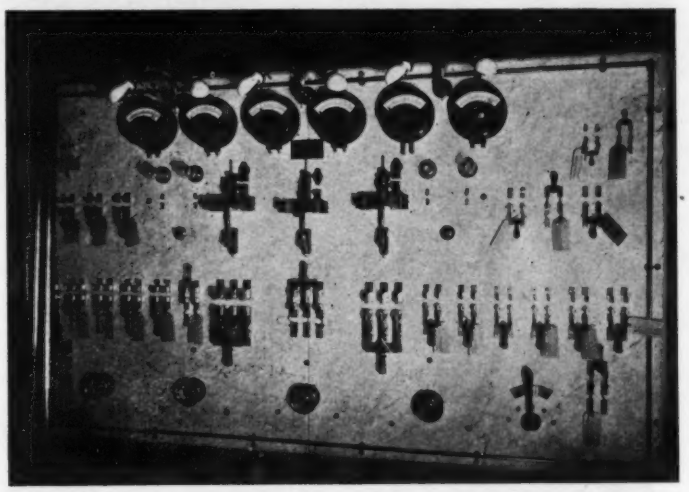
The electric plant is installed on the left side of the boat and receives its steam at a pressure of 40 pounds, the regular pressure from a marine boiler. A Stratton separator delivers it free of moisture. The whole steam piping system is covered with magnesia. The steam is fed to three Armington & Sims engines, each directly coupled to a Westinghouse dynamo. The largest generator set is rated at 80 horse-power and runs at a speed of 275 revolutions per minute. The engine is the standard pattern and has an automatic governor controlling the cut-off with the customary piston valve. The bed-plate of the generator is bolted to the bed-plate of the engine and the armature is mounted directly on the engine shaft. The generator is a six-pole machine rated at 50 kilowatts and will supply 400 amperes at 110 volts. It is compound-wound, and a good idea of it together with the engines may be obtained from Fig 1. There are two of these larger units, the third being a little 15-hp Armington & Sims engine running at 380 revolutions. This is flexibly coupled to a four-pole Westinghouse generator mounted on a separate base. This little machine, which may be seen in Fig. 2, will supply a hundred lights and is rated at 10 kilowatts. The engines exhaust into a Worthington jet condenser and the condenser water is pumped overboard.

The generators run in multiple with the equalizers which are connected to an equalizer bar by the throw of a three-pole switch. From the bus-bars, which are back of the switchboard, 25 circuits are tapped Most of these circuits supply only suitable portions of the boat with light, but several others have more interest. Among them is a search-light circuit, which is designed to carry about 25 amperes, a rheostat being provided on the switchboard and regulated by hand to keep the current within this limit. Another circuit supplies a Lundell direct-coupled fan motor which is also controlled by a rheostat.



MAIN SALOON OF STEAMER ADIRONDACK.

Each machine, of course, has the customary rheostatic control. In the circuit of each machine also is a Westinghouse circuit-breaker. This, as has been frequently stated in THE ELECTRICAL WORLD, is a modern innovation in lighting stations and a very good one. There is no more reason why a circuit-breaker should not do just as efficient duty on a lighting system as on a railway system, although perhaps it would not be so frequently called into service. It is far more cleanly, convenient and reliable than a fuse. The output from the switchboard is measured by two voltmeters and four ammeters of the Weston round pattern, each of which is lighted by a lamp as shown in Fig. 3. Three ammeters measure the output of the three machines; one voltmeter measures the bus-bar voltage and the other is adapted to measure the pressure of each machine before throwing it into circuit. The fourth ammeter is in the search-light circuit.



SWITCHBOARD OF STEAMER ADIRONDACK.

The wiring is done entirely in brass-armored conduit, lead-covered cable and the American Circular Loom conduit being used, depending upon the conditions. They supply current to the lamps through a Habirshaw wire which was specially made by the Habirshaw Company for the steamer. This wire is exceptionally well insulated and the extremely favorable report of the inspectors for the Board of Underwriters speaks very well for its insulation resistance.

The arrangement of the lamps in the boat in some places is worthy of notice as being out of the ordinary. In the dining-room the lamps are arranged in rows upon the ceiling in receptacles, while in the main saloon, a portion of which is shown in Fig. 4, most of the lighting is furnished by the pillar fixtures. The chandeliers are beautifully decorated and are entirely in keeping with the decorations on the interior of the boat which is finished in white, Nile green and gold. In the saloons are switch cabinets controlling 18 sub-circuits. These cabinets are finished in the same exquisite manner as the panels of the wall, have a beveled glass door with ground ornamentation and contain a large number of baby knife-switches and a main switch controlling the output of the whole cabinet. Each stateroom is supplied with a lamp and socket. The lamps are of the Sawyer-Man make and Westinghouse sockets are used.

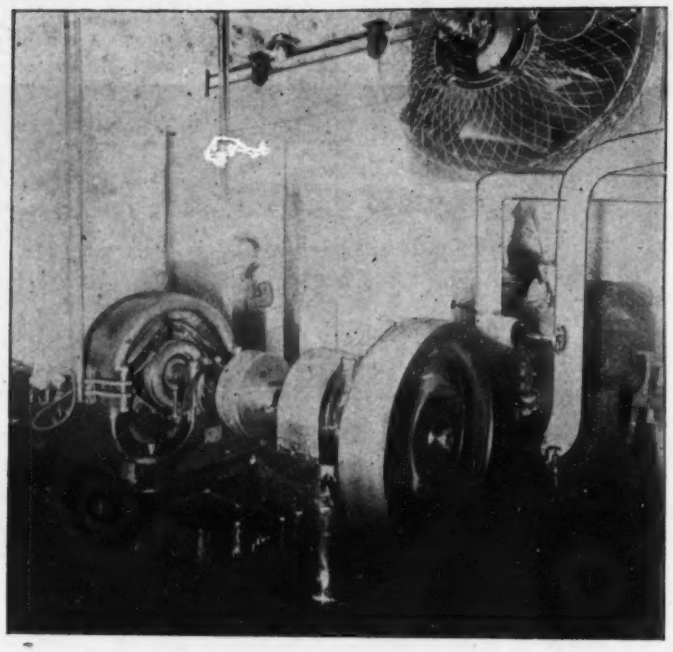
The signal lights of the boat, both starboard and port, are electric, and a Russell See indicator is placed in the pilot-house, which gives prompt warning if either of the side-lights becomes extinguished. The search-light is placed on the top of the pilot-house.

The plant, while not a large one, is complete in its equipment and thoroughly modern, and no expense has been spared to make it all an engineering and æsthetic taste could desire.

The total capacity of the plant is 1750 lights and the usual load is about 1300 lights. The wiring was done by Mr. J. P. Hall, while

Mr. S. E. Drake, of the Westinghouse Company, superintended the installation of the dynamos.

The *Adirondack* was modeled and designed by Mr. John Englis, vice-president of the People's line, and was constructed by Mr. Charles M. Englis, of the firm of John Englis & Sons, of Brooklyn, N. Y. The keel was laid at Greenpoint, N. Y., and on Nov. 20 the vessel was launched. The hull is 412 feet over all and 400 feet from the water line. The beam is 50 feet and the overguard 90 feet. The draft is 8 feet. She has 4500 tons gross and 3000 net capacity, with a freight capacity of 1000 tons. There are six masts, each 82 feet



Engine Room of Steamer Adirondack.

long and 24 inches in diameter. The vessel is provided with collision, boiler and engine bulkheads, and the boiler department is separated by steel partitions from the rest of the vessel on account of fire conditions. The vessel has five decks. The engine has a capacity of 4000 horse-power and turns two 30-foot paddle wheels, each having 12 curved steel buckets, each bucket being 45 inches deep by 12 feet by 8 inches wide. The boat is also provided with both steam and hand-steering apparatus.

Automatischespiegelglassplattenblitzschutzvorrichtung.

This little device, referred to quite innocently by a German contemporary, is as its name clearly indicates (when read backwards), simply an apparatusforprotectingagainstlightningconsistingofplatesofmirrorglassactingautomatically, or as we would say more briefly in this country, where time is money, a form of "cut-out." It is to protect circuits against lighting, and although its name describes it in detail, the description is not full enough. A narrow strip of silvered glass is scratched on the metal side with numerous transverse lines (called in German, Zwischenraumbreiten), their number depending on the voltage of the circuit. One end of this strip is connected to the line and the other to the earth. The atmospheric electricity will pass over the scratches, but the dynamo current will not follow. Although simple, cheap and effective, its name is a fatal objection to its use in this country.

Accumulators and Horseless Carriages

Sir David Salomons, who is held to be quite an authority in England on accumulators, states, in a recently published pamphlet on horseless carriages, that accumulators are not suitable for public traction, as the motive power weighs too much. A light accumulator, which he says is alarmingly heavy at the best, is not as efficient as one of a heavier type, which latter he prefers to use.

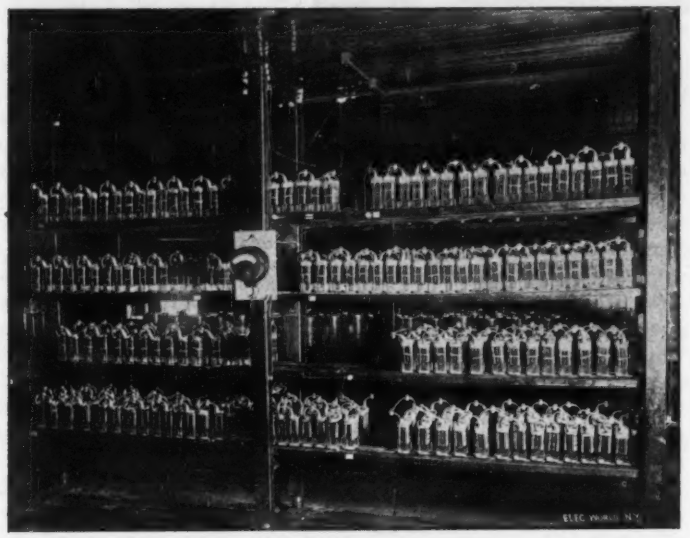
Humane Lightning.

During a recent thunder-storm at Drung, Ireland, a woman was engaged in milking a cow in a shed, in which there was also a calf, a dog and a cat; the lightning, according to the London *Electrician*, struck the shed and killed the four animals, but the woman escaped.

The Storage Battery for Fire-Alarm and Police-Telegraph Purposes.

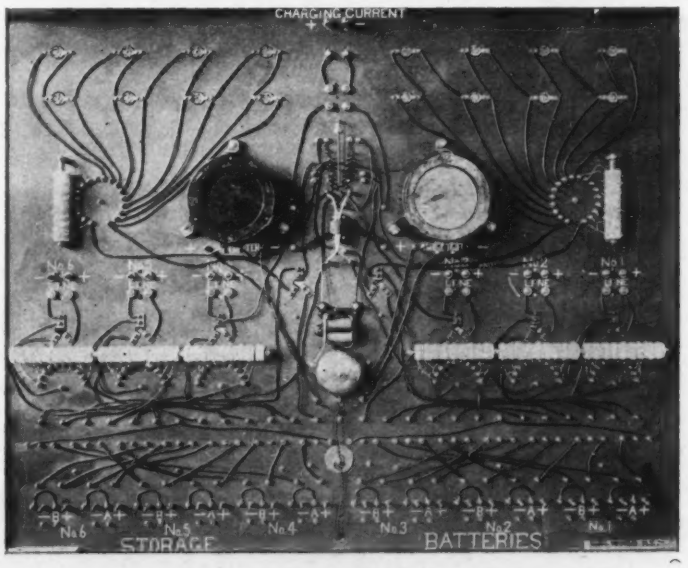
BY JOHN L. HALL.

Considerable has been written on the subject of accumulators in telegraph and signal work, but it has been deemed advisable to briefly explain the new installation which the writer has just completed for the fire alarm and police telegraph of Wilmington, Del. The entire installation is the most important thus far made for fire-alarm purposes, and consists of 470 Type B3 (six ampere-hours) chloride accumulators, replacing the same number of gravity cells. The battery is divided into 22 separate units, ranging from 7 to 30 cells, each of the 11 circuits having its battery in duplicate.



Accumulator Plant, Wilmington, Del.

The increased economy brought about by the use of storage batteries is likely to prove confirmatory of the claims hitherto put forth. At the rate secured for charging current there will be a saving of $1200 per year over the cost of maintaining gravity cells during the past year. As the battery is guaranteed for three years, the expense of charging will be the only one to which the city will be subjected. Its cleanliness, absolutely steady current, great saving of floor space

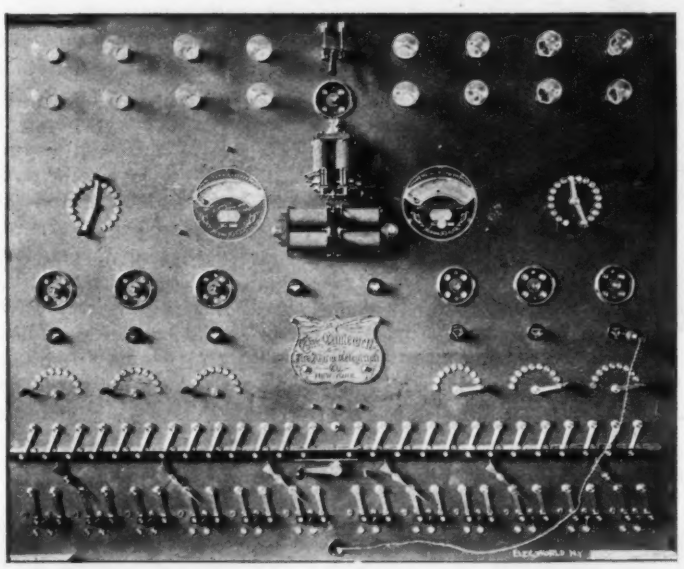


Back of Switchboard, Showing Connections.

and reduced attention necessary for proper maintenance are among the chief factors for its adoption.

A great deal of data gathered by the writer directly from those in charge of storage-battery installations for fire alarm and telegraph purposes, some of which have been in operation for more than a year, speak well for its reliability. In some cases not a single element has been removed, and in others where proper means have been taken to prevent evaporation, no attention whatever was required.

An accompanying cut illustrates one tier of the battery as installed. The switchboard for this plant was designed by Mr. N. H. Suren, and built by the Gamewell Fire Alarm & Telegraph Company, and is one of the largest in use. It is of slate, 4 feet x 8 feet, and affords about all the automatic protection against accidents or carelessness that could be devised. There are six charging circuits in multiple with the service wires of the Wilmington City Electric Company at 119 volts pressure. These charging circuits are the six upper jacks in the illustration. Two sets of batteries in series, not exceeding in this case 41 cells, are thrown across each circuit. This allows one set to be charging while the other set is supplying the lines. The current from the street mains passes through the switch at the top of the board, then through a fuse entering a polar and neutral relay, and finally to the lamps and resistance coils. These coils and lamps are thrown in or out to meet the requirements of the number of cells in any charging circuit. In case of a reversal of polarity of the charging current, the armature of the polar relay falls on the back stop and rings a bell until the proper polarity is restored. If the charging dynamo is stopped, the neutral relay opens and breaks circuit at a series of contacts, preventing the batteries from discharging through the leads and the armature of the dynamo. The fire alarm and police circuits are



SWITCHBOARD.

brought into the gang switches, passing through a fuse, spring jack and resistance coil. The fuse prevents injury to the discharging battery in case of a short circuit on the line. The resistance coil has a sufficient number of steps to make the line current uniform or to carry it over a sudden drop, while the contacts allow the voltmeter and ammeter to be thrown on any circuit. The gang switches are moved to the right or left by means of a connecting rod, rack, pinions, etc., and pointers are attached to these switches to indicate which of the two sets of batteries is being charged. Below the gang switches are 24 switches connected in pairs, to the terminals of which the batteries are brought. These have an "on" and an "off" position. When the switch is "on" its battery is either feeding the line or being charged, and if the latter, the pointer on the gang switch always points toward it. Throwing the switch to the "off" position bridges over the connections and gives the current a circuit through the board independent of the batteries, which can then be opened for repairs or inspection. There is absolutely no break in throwing the circuits from charging to discharging sets of batteries, a highly essential feature in fire-alarm work. A glance at the pointers on the "on" and "off" marks renders it almost impossible to make a mistake in handling the board.

The spring jacks mentioned are all three-way. The two lower springs short-circuit the ammeter through the special contact points. The other spring is in multiple with these two. When the plug is inserted it spreads the two lower springs and cuts the ammeter and voltmeter in with one movement. There is a portable low-reading voltmeter for testing the individual cells which are also expected to be tested in the usual way by a hydrometer. The photograph of the back of the switchboard represents a six-circuit board, but the arrangement is the same as on the 12-circuit board and illustrates completely the method of wiring.

Experiments with the Polarizing Photo-Chronograph in Determining the Motion of Projectiles Inside the Bore of a Gun.

BY ALBERT C. CREHORE AND GEORGE O. SQUIER.

(*Continued from page 769, Volume XXVII.*)

The acceleration which the point has is algebraically expressed by the second derivative of s with respect to the time, which is

$$\frac{d^2s}{dt^2} = a = 6t - 6. \qquad (3)$$

This second derivative is also represented by a curve which may be derived graphically from curve II. as II was from I. When this is constructed, the points will lie upon the straight line III, which crosses the t axis at a point directly above the lowest point of the parabola, where $t = 1$, since here at the minimum point the tangent is zero and the velocity is not changing. Equation (3) when traced coincides with this line, which represents the acceleration-time curve, and indicates that the law of motion of the point is a uniformly increasing acceleration.

The more desirable relations required in interior ballistics are those between velocity and space, and between acceleration (or pressure) and space, so as to know what the velocity or pressure is at any point of the bore. These relations may be derived graphically from curves corresponding to I, II, and III by a process to be described. This may sometimes be done algebraically, but the process involved consists in eliminating one variable between two equations, which in general is not a simple problem. If the variable t is eliminated between equations I and II, the desired velocity-

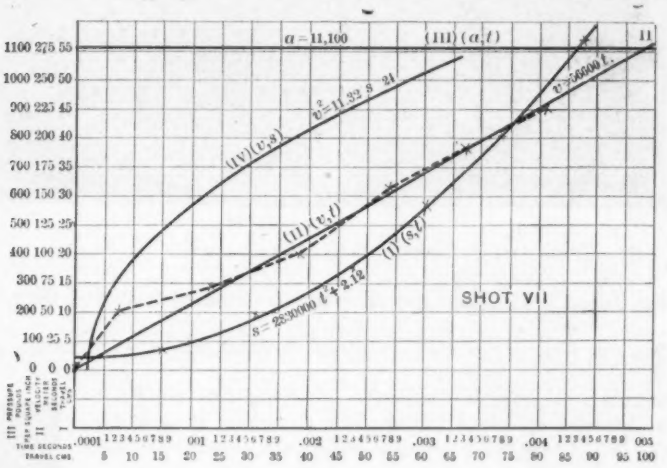


FIG. 6.

space equation will be obtained, and the result seen to be a higher degree equation. The graphical solution of this, however, is simple and represented in Fig. 9 by curve IV. To obtain this make use of curves I and II. To obtain any point as M on the new curve, measure the ordinates of curves I and II, corresponding to the abscissa OH, and take HK as the abscissa, and HG as the ordinate of the new point. This locates the point M on the new curve and a similar construction gives any point on the velocity-space curve. By eliminating t between equations (1) and (3) the acceleration-space curve is obtained, or graphically by a similar construction as before between curves I and III, the points of curve V are obtained, which is the required acceleration-space curve.

DATA.

To illustrate the results obtained, the data for a single shot is given.

Shot VII.

Aug. 26,, 1895.

Weight of projectile, with rod, 15 pounds 7 ounces.

Weight of charge, 3 pounds 13½ ounces.

267.075 degrees of the tuning fork record correspond to 23 waves. Hence

$$\omega = 5940.8 \text{ degrees per second.}$$

No.	s (cms)	θ (degrees)	t (seconds)
1	3.81	4.472	.000753
2	9.60	9.366	.001577
3	17.86	14.105	.002374
4	27.90	17.955	.003022
5	40.66	21.952	.003695
6	57.15	26.239	.004417

The distances s are measured along the rod from the inner side of the copper band nearest the muzzle, which was in each case so adjusted that the first movement of the projectile from its seat would break the chronograph circuit. This is evidently the zero point from

which to measure the travel of the projectile. The angles θ are measured upon the negatives from that break of the chronograph record, which corresponds to the first motion of the projectile just

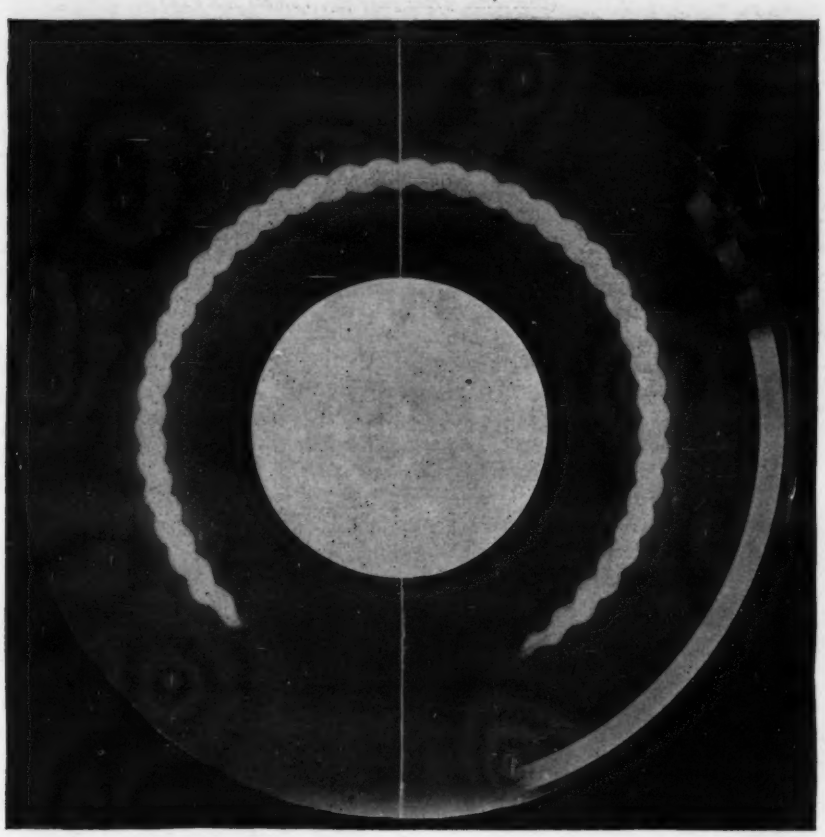


Fig. 7.

mentioned. The corresponding time is obtained from θ by the relation $t = \frac{\theta}{\omega}$ which holds for uniform rotation where ω represents the angular velocity of the plate. The angular velocity ω is obtained from the tuning fork record by measuring the angle so obtained by any convenient number of complete waves.

The angle subtended by 23 waves is in this case 267.075 degrees and the time corresponding to one compete wave of the fork used is known to be $\frac{1}{512.081}$ of a second. This determines the angular velocity of the photographic plate which is $\omega = 5940.8$ degrees per second, or 16.50 revolutions per second, or 990 per minute.

The data for this shot is also represented in Fig. 6. To find the velocity-time curve from the observed points on the space-time curve, divide the space increment by the time increment between successive points and obtain the points indicated by the broken dotted line II. It is seen that these points do not follow any pronounced curve, and inspection shows that a straight line suitably located represents the points within the limits of error as nearly as any curve. This suggested trying the velocity-time curve as a straight line, which, of course, means that the space-time curve must be a parabola, and finding the parabola which would most nearly pass through the observed points. Curve I shown in the figure is a true parabola whose equation is $s = 2,830,000.\ t^2 + 2.12$ where s denotes travel in cms, and t time in seconds.

The first observed point does not lie upon the parabola so closely as the others, which it will be seen is to be expected. The third point, which is seen to be the furthest from the curve, differs from the curve in point of time by about a single small square or $\frac{1}{1500000}$ of a second.

As soon as it was found that a parabola could be fitted to the observed points as closely as this, there was no reason to try other and more complicated formula than that of a parabola, which are usually advocated.

The equation of the velocity-time curve, found by differentiating the former equation with respect to t, is $v = 56,600\ t$, where v is expressed in metres per second, and t in seconds. The velocity-space curve found by eliminating t between the two equations given $v^2 = 11.32\ s - 24$ and is also a parabola. The acceleration-time equation is found by differentiating the velocity with respect to t, and is $a = 5,660,000$ centimetres per second, which is 5740 times the acceleration of gravitation, and is constant. Since acceleration is directly proportional to the pressure on the projectile (neglecting friction) it follows that the pressure over the distance where the parabola coincides with the observations is approximately constant. It must not be inferred from this statement that the parabolic law involving constant pressure, found to be so approximately true through a certain range of the travel, obtains for portions of the bore either in rear of or in advance of this region. In fact, it is well established, especially for quick-burning powders, that the pressure sensibly decreases along the chase. As to the very first motion of the projectile which caused the first signal on the chronograph, it is seen from this and other figures that the first point invariably lies below the parabola and usually considerably off from it as compared with the others. This of itself indicates that there is considerable departure from the parabolic form, and it seems to be confined to the first few (about five) centimetres from the origin, corresponding to about $\frac{1}{1000}$ of a second. In other words, for the powder used and the conditions of loading employed, the point of maximum pressure seems to be located within this region. In any case this is the region of greatest changes of all kinds, and although most important to know as far as gun construction is concerned, yet it is the most difficult to measure. It seems clearly settled, however, that this maximum point, under the above named conditions, lies nearer to the origin than has heretofore been supposed. We have only succeeded thus far in obtaining a single point that seems to lie within this region of maximum pressure, which is manifestly far from being sufficient to determine the exact position of it; but if slower burning

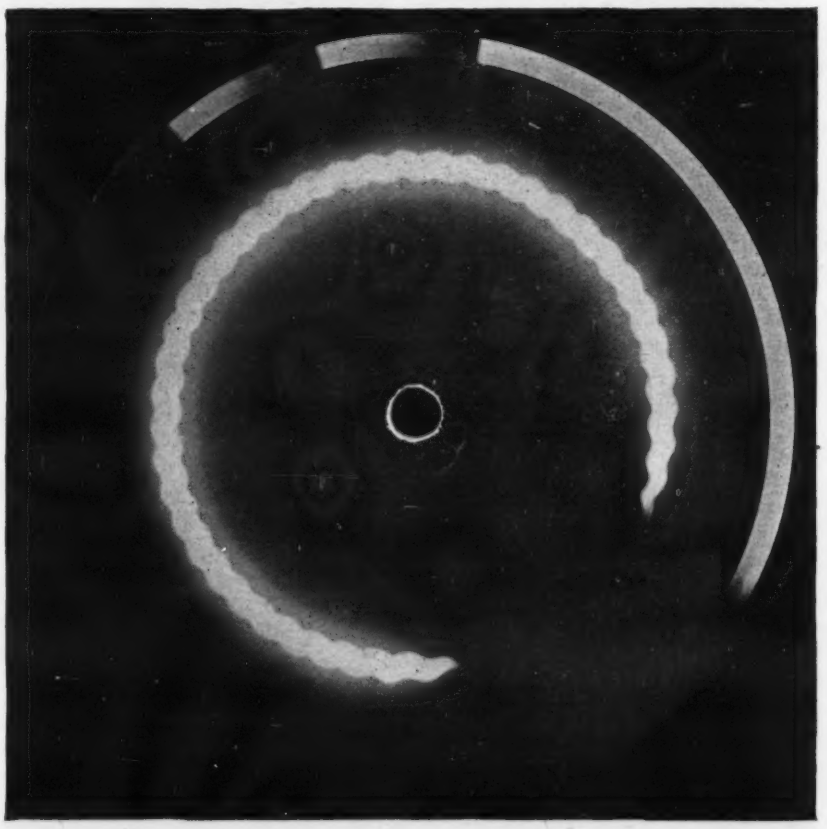


Fig. 8.

powder had been used it looks quite probable that the maximum point might be approximately located.

It is naturally of interest to see what muzzle velocity the parabolic law gives, assuming it to hold for regions of the bore in front of the observations. The travel of the projectile using common shell, meaning the distance from the base of the projectile in its seat to the muzzle, was measured to be 184.4 centimetres. In the case of shot No. 7 the equation for the velocity space curve is $v^2 = 11.32\ s - 24$. Substituting the muzzle-distance for s, we have $v = 446.2$ metres per second. In case of shot No. 9 the corresponding velocity is 423 metres, and for shot No. 5 it is 421 metres.

To obtain an idea of the appearance of a record for interior, as compared with exterior ballistics, refer to Figs. 7 and 8.

The intervals between screens for the exterior record were about 10 feet.

CONCLUSION.

When the two objects of these experiments mentioned in the beginning of this paper are kept in view, namely; first, to improve the instrument, and second, to obtain measurements of the motion of projectiles through the bore without mutilating the gun in any way, it may be said that the two vital parts of the instrument have each been improved. These parts are the chronograph and tuning fork records, upon which the measurements are made. The intensity of the light for the chronograph record has been increased as described by the use of lenses, so that it is even more quick in its response to breaks in the electric current than formerly. This becomes a more important matter where the measurement is upon projectiles inside the bore than it was for exterior ballistics, because the time intervals to be measured are generally much shorter in the former case.

The improvements in the tuning fork records are more noticeable in the photographs than those in the chronograph records. The photographs, an example of which is shown in Fig. 2, are easily obtained, and have the wave-lengths so clearly defined that there is little to be desired in point of accuracy. These records are interesting from a purely physical point of view, and when it is understood how easily they may be obtained, it seems certain they must find a place in laboratory investigations where former methods left so much uncertainty as to the exact location of the maximum points of the waves.

Naturally many radical changes in the camera formerly used were suggested, such as the employment of sensitized films instead of a plane glass plate; and such as a form of instrument in which the plate is stationary while the beam of light revolves. The process of developing and subsequently drying a film is too liable to cause change of shape which renders its use wholly unsuited for such accurate measurements as are involved. The first instrument required the sensitive plate to be mounted like a circular saw upon its shaft, requiring a hole in the negative itself. The new instrument will permit the use of ordinary commercial plates mounted in plate holders so that the plate and holder revolve together. Allowance is made for the varying thickness of the glass, and consequent eccentricity of the centre of gravity, by mounting the whole in a comparatively heavy well balanced fly-wheel.

It should be said that the original camera is the only one which has as yet been used in the experiments already described. A new instrument is now almost completed, being manufactured by J. A. Brashear, of Allegheny, Pa. A special form of instrument to accompany the chronograph for the purpose of accurately measuring the angles obtained on the negatives is in the hands of Messrs. Warner & Swasey, of Cleveland, O., makers of astronomical instruments. It is expected that these instruments will be installed at the United States Artillery School, Fort Monroe, Va., and be ready for use during the coming Summer.

As to the second object mentioned above, it may be said that as many as seven observations of the projectile were taken in a distance of 57 cms (only 1 foot 10½ inches) somewhat less than one third the whole travel of the projectile, which is 184.4 cms. The shortest distance between observations was 3.8 cms (about 1½ inch). The greatest distance observed along the bore was about 76 cms (2½ feet). No attempt was made to remove what is thought to be the cause of the breaking of the rod, and with it the limitation to the distance measured along the bore, on account of lack of time to do more than obtain the results mentioned. It is thought, however, that these observations can be extended still further along the bore than they have as yet been observed.

An important point to be kept in mind is that the method used permitted a single mechanic working all day to prepare all the material used for a single round, so that for more than a week consecutively one shot was fired per day. This, moreover, was under experimental conditions, which obviously required more time than it would to do the same thing under other conditions; for example, the distances on the rod between the copper bands of the succeeding shot were not determined until the preceding shot had been fired and the negative examined. It would be perfectly feasible to keep these rods already prepared for the special use of taking interior velocities. In that case the operation of observing a projectile inside the bore is almost as easily performed as observing it outside.

Although what has been said in this paper applies more particularly to the experiments with a 3.2-inch field rifle, it is not to be inferred in consequence that there is no application to guns of larger calibre. On the contrary, there is much reason to believe that experiments upon big guns, though the preparation for each shot may require a larger plant and take more time, will be even more successful than with a 3.2-inch rifle. The first part of the travel is unquestionably an important one to know something about, and, for an equal distance in the two guns, the velocity of the projectile may be much slower in the big gun. Even though the observations could not be extended throughout the entire bore, it would be a particular advantage to measure the first part of the motion.

Effect of Temperature on Insulating Material.*

BY CHAS. F. SCOTT.

In the discussion of the paper on "Effect of Temperature on Insulating Materials," I referred to certain tests made by Mr. C. E. Skinner. Mr. Skinner has kindly furnished the following statement of some results which he has obtained in his work in this line:

"Some time ago a series of tests were undertaken to determine the effect of temperature on the insulation resistance and breaking down E. M. F. of various insulating materials and of completed apparatus. A large number of insulating materials, including paper, cloth, etc., both in the treated and untreated forms, were tested. The tests on completed apparatus were made on armatures, fields,

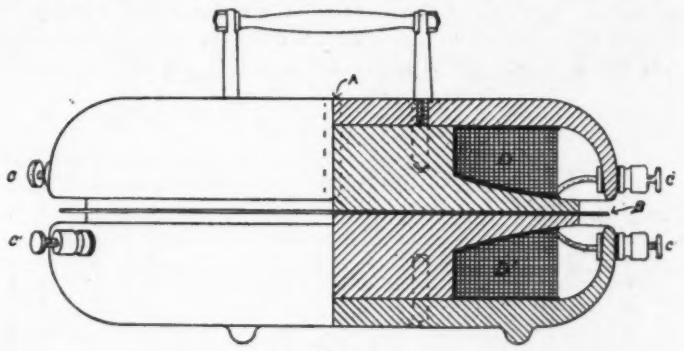


FIG. 1.

converters, etc., these pieces of apparatus being treated in various ways before the tests were made.

"(1) *Tests on Insulating Materials.*—Various methods of making these tests were tried. The apparatus illustrated in Fig. 1 was finally adopted for standard tests as being best suited for practical work. This piece of apparatus consists of two similar parts, the two parts forming the plates between which the insulating material is placed when tested. These plates are 10 inches in diameter and are carefully surfaced. Each part is made of two separate pieces of cast-iron, fastened together as shown, and wound with a coil of asbestos-covered wire. The heating of the apparatus is effected by sending an alternating current through the two coils in series. The heating results from the eddy current and hysteresis loss in the iron as well as from the copper loss in the coil. The rate of heating can be controlled easily by means of a suitable rheostat in circuit with the coils, the mass of iron in the heater being sufficient to prevent sudden changes of temperature from outside causes. The insulation resistance of the samples was measured in all cases by means of a high resistance voltmeter on a 500-volt circuit, all wires of the heating circuit being disconnected when the insulation measurements were made. This method of measurement was adopted on account of the portability of the apparatus and the facility with which the measurements could be made, a complete measurement of insulation resistance requiring from 10 to 15 seconds. Ordinarily the time occupied in making a complete test on a sample of material was from one to two hours. Insulation resistance readings were made at frequent intervals.

"In Fig. 2 is given a curve obtained from tests on a piece of untreated paper which is largely used for insulating purposes. As will

* Communicated after adjournment of the annual meeting of the American Institute of Electrical Engineers.

be seen, the minimum resistance is reached at slightly below 100 degrees C. From this point the resistance rises rapidly until it reaches a point too high to be measured with the apparatus used. The absolute value of the insulation resistance of any material of this class depends on the amount of moisture in the material at the start, the rate of heating and the chance for the escape of moisture during the test. The temperature at which the insulation resistance is lowest depends slightly on the rate of heating. The curve shown in Fig. 2 is characteristic of all materials of a fibrous nature which do not contain chemicals or materials which are readily changed by heat. The absolute values of the insulation resistance for different materials or even for two samples of the same material are rarely the same, but the general shape of the curve has been found to be practically the same for all such materials, the tests extending over a period of several years and being made in many ways.

"The curve for treated material, such as oiled-paper, is similar to the curve shown in Fig. 2. The absolute value of the insulation resistance depends largely on the drying of the material before treatment. Samples of cloth which were treated with linseed oil after being thoroughly dried and then the oil baked on, do not at any time show a very low insulation resistance, even at a temperature of 150 degrees C.

"In Fig. 3 are shown curves for a sample of .015' calendered press-board. This press-board is made of a mixture of scrap paper and rags. The test on this sample was made as follows: The temperature was gradually raised to 120 degrees C., the time occupied in reaching this temperature being 30 minutes. The temperature was maintained constant at 120 degrees for 31 hours. At the end of this time the temperature was increased to 280 degrees. At the end of 30 minutes the insulation resistance had fallen from 85 megohms to less than one megohm and again risen to about 12 megohms. The lowest point reached was .032 megohms. At the end of 70 minutes the insulation resistance had become too great to be measured by the apparatus at hand. Frequent readings were taken during the 31 hours' run at 120 degrees C., but at no time was it possible to measure the insulation resistance. When the temperature was again raised at the end of 31 hours, the insulation resistance again fell. At 150 degrees the first measurements could be made. At 195 degrees (point *c* on the curve) the first smoke was noticed issuing from between the plates. At 220 degrees C. (point *d* on the curve) smoke was issuing in volumes from all sides of the piece under test. At 280 degrees the sample was charred to such an extent that the edges extending beyond the heating plates were broken off. At this point the test was unavoidably stopped. Sixty hours later, the sample not being disturbed in any way, it was found that the insulation resistance was above 100 megohms.

"(2) *Tests on Completed Apparatus.*—In Fig. 4 is shown a curve taken from tests on a motor armature which was wound without previous drying of any of its insulating materials. The motor was run with an overload and measurements were made at frequent intervals. The temperature could not be taken until the end of the run, when it was found to be about 110 degrees C. The drop in the curve at the points *a* and *b* is accounted for by the fact that the load was increased at these points, thus increasing the temperature of the armature. The lowest insulation resistance reached in this test was 4500 ohms. At the end of 70 hours the insulation resistance on the armature had become so high that insulation resistance measurements could not be made. After standing for 17 days the test was repeated. The general shape of the curve for the second test was the same as for the first, but the insulation resistance did not drop so rapidly nor so low, the lowest point reached being 500,000 ohms. Insulation resistance measurements made on the fields at the same time show that the resistance of this part did not drop so rapidly, but remained low for a longer time. This is explained by the fact that there is a greater amount of wire in the field coils and not so good a chance for the escape of moisture. The curve in Fig. 4 is characteristic of all apparatus tested. The lowest values reached, however, for different apparatus, vary greatly with the character of the apparatus and the previous treatment. Motors which were wound with materials which had been treated, then dried, and the motors again dried after being wound, show the best results.

"(3) *Relation Between Breaking-Down E. F. M. and Insulation Resistance.*—An attempt was made to establish the relation between the breaking-down test of insulating materials and their insulation resistance. For this purpose samples of paper, which gave a very uniform breaking-down test in the normal state, were heated up until the insulation resistance reached a certain predetermined amount, when the breaking-down test was quickly made. It was found impossible to establish any definite relation between the two, even for a given material. It was found, however, that a low insulation resistance usually meant a low breaking-down test, but a low breaking-down test did not necessarily mean a low insulation resistance. These two tests may be compared to the chemical analysis and the tensile test of iron. A poor chemical analysis means poor physical qualities, but a good chemical analysis does not indicate whether or not there are flaws in the metal.

"(4) *Conclusions.*

"(*a*) The insulation resistance of all ordinary fibrous insulating materials, such as paper, cloth, etc., decreases upon being heated up, and then increases again when the moisture is expelled.

"(*b*) Continued heating of 31 hours at 120 degrees C. does not lower the insulation resistance of paper.

"(*c*) The insulation resistance of completed apparatus shows the same characteristics as the insulation resistance of materials taken separately.

"(*d*) A low insulation resistance is not necessarily an indication of poor insulation, but probably an indication of the condition of the apparatus in regard to moisture.

"(*e*) A high E. M. F. should not be applied to apparatus when the insulation resistance is low.

"(*f*) Material which is badly deteriorated mechanically by heat may still have a high insulation resistance, but very poor insulating qualities."

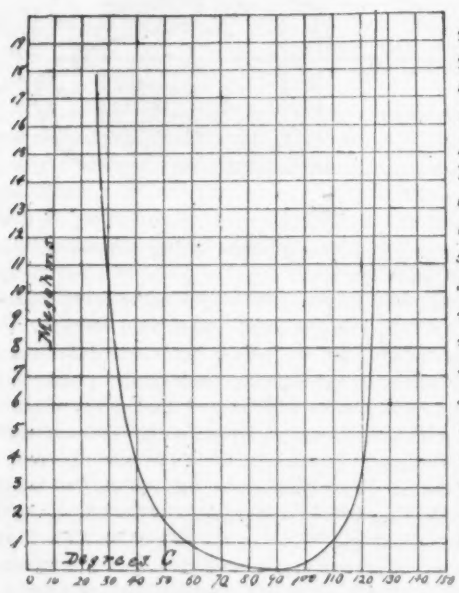


Fig. 2.

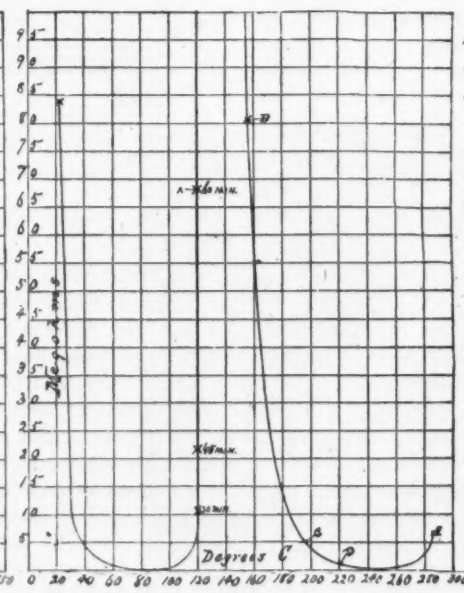


Fig. 3.

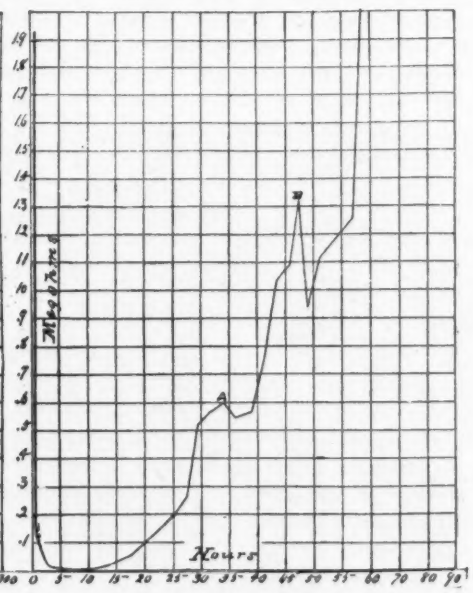


Fig. 4.

Municipal Ownership of Electric and Gas Plants.*

BY ALLEN R. FOOTE.

I have tried to show that municipal ownership is wrong in principle. If it is, it is foredoomed to failure in practice. I have had too much experience in dealing with statistics to permit myself to deal largely with data that I cannot verify. Every person who honestly undertakes an intelligent discussion of this subject feels the fatal lack of accurate data.

None should be so inaccurate as to suppose, without a careful personal examination into all local conditions, that the result given for one town can be used as a standard for any other town.

One of the most notable examples of municipal ownership of a gas plant is found in Philadelphia. If the accounts of that venture were accurately written out, they would show it had been unprofitable with a service rendered by a private corporation.

The most notable example of the municipal ownership of an electric light plant is furnished by the City of Chicago. Mr. Fred Deland, of Chicago, showed that the cost, excluding allowance for taxes and insurance, for operating the municipal plant, to be $153.48 per arc-lamp per year. Unreliable quotations of the cost of operating this plant have damaged the electric lighting business of this country many times the value of the plant. It is a well known fact that a private company is ready any day to contract to furnish light at a less cost than the city can produce it from its own plant.

The most recent champion for the honor of demonstrating the economy of municipal ownership of an electric lighting plant is the City of Detroit. In 1893 legislation was secured, permitting the city to bond itself for $600,000 for the construction of a municipal plant, that was to produce arc lights for $84.00 per year. The plant had been in full operation but three months when the city papers came out with the startling headlines: "Dollars in Pocket," "Saving So Far Shown By the City Lighting Plants, Average Cost Per Lamp Per Month Is Only $7.20." Another paper makes the statement: "Cut in Half. Street Arc Lights Cost a Little More Than $85.00."

The last contract made by the City of Detroit with a private company was at the rate of $137.80 per lamp per year. This was previous to the panic of 1893. At the time the City of Detroit took this action, I stated that the act of the Legislature granting authority to issue bonds and erect a plant had been obtained on insufficient evidence. That the plant would cost more than $600,000, and that the lamps would cost more than $84 per year to operate. The plant cost about $650,000. Mr. Dow, the electrician in charge, states that the "operating cost, plus maintenance, interest, sinking fund to bonds and a 5 per cent. theoretical depreciation, is practically $100 per arc per annum, and is substantially true." It will be observed that this "substantially true" statement allows but 5 per cent. for depreciation and makes no allowance for the taxes a private company owning the plant would have to pay. This certainly is a remarkable statement made by the city electrician, called out by a criticism of the flaming newspaper accounts of the great saving effected by the city plant, by those who know how to read between the lines.

The Detroit municipal plant has been running about nine months; already there is a demand for an additional $200,000 for extensions, and the substantially true cost of operating the lamps is far above the $84 which was the promised performance.

The depreciation of a plant by use is as much a part of the cost of operation as is the coal bill or pay roll, and should be fully included in every statement of cost.

Any other cause will lead to an inevitable disaster. In private corporation management, the omitting of this item of cost and a consequent showing of an abnormally large profit, invariably produces two results.

First: It causes the City Council and private consumers to make a common cause of a demand for reductions in price, and those restless spirits who seek the public good through every excuse they can find for "downing a monopoly" to agitate the cause of municipal ownership, the enormous (?) saving they show, as is now the case in Detroit, being entirely due to the omission of a part of the items of cost.

Second: Twenty years hence the municipal taxpayers and the corporation shareholders will not be "man for man, and interest for interest the same persons" that occupy these relations to-day. If the cost of depreciation is not collected and set aside month and month, and year by year, from the beginning, future taxpayers and shareholders will be robbed for the benefit of those now in position to be benefited by the robbery.

There is not a municipally owned gas or electric light plant in the United States which private capital will not take over and operate under contract at the same price the service is now costing the municipalities, all factors of cost being correctly and fully considered, and all franchise rights enjoyed by the municipalities being assigned to the purchasing private corporation.

Mr. Hunter, of Allegheny, said: Previous to July 17, 1890, the City of Allegheny, Pa., was lighted by gas and gasoline lamps, using about 1800 gas and 400 gasoline lamps. Upon the above date our electric lighting system started with three hundred and sixteen 2000-cp arc lamps, and two thousand 16-cp incandescent lamps (the latter in city buildings). The system has been increased steadily, and at this latter time we have 925 arc lamps and 3000 incandescent lamps, the latter in public buildings (service continuous). That our people appreciate and approve of the ownership of their public lighting system, it is only necessary to mention the vote taken in the latter part of 1894 on the question of issuing bonds to the amount of $100,000, for the purpose of electric light extension; the result was almost unanimous in favor of the issue. Our arc lighting lines extend to the city lines in all directions.

Cost of arc lighting system	$250,994.41
Cost of incandescent lighting system	89,500 00
Total	$340,494.41

* Abstract of a paper read June 18, before the Convention of Street Lighting Officials, New Haven, Conn.

Electric Street Lighting.†

BY M. J. FRANCISCO.

You are lead to believe that there is no depreciation in an electric plant. What has been the past experience of municipalities and corporations; Wabash, Ind, paid $18,000 for an outfit, and after six years sold it for $30. Xenia, O., paid $35,000 for a plant and after eight years sold it for $10,000. Moline, Ill., paid $15,000, and after four years sold it for $8000. Oxford, O., paid $25,000 for a plant and now they say they can replace it for $12,000. Michigan City, Ind., paid $10,000 for a plant and sold it for $2500. On this question of depreciation I can speak from experience. I have sold apparatus costing $4000, after using same six years, for $500. These cases demonstrate by actual experience that the question of depreciation is a very serious one. In many cases the authorities have been deceived, and not understanding the practical part have been induced to adopt a plan which has been very disastrous. We have a very recent illustration of the risk which a private corporation has to assume. At the time of the tornado at St. Louis a short time ago, in an hour's time property of electric companies worth over half a million dollars was entirely wrecked. Should a municipality whose province it is to govern and regulate, assume such risks, and enter into a business subject to such losses? The private companies must meet such things, but have you ever heard of a case where such losses have been charged in the accounts of the electrical department of a city producing their own light. In addition to such losses there is a liability, not only to the employees but to the public, for accidents caused by the current, and many times these claims have amounted to $100,000. When a city contracts with a private company they are guaranteed against all such claims and damage, but if they own the plant they must assume and pay such damages, and they are a part of the expense of the business, but you never see them reported in the lighting expense. It has been stated that the total cost of production of a full arc per year is $40 per year in Marquette, Mich. The Mayor states in his annual address "that there was a profit of between $4000 and $5000 a year," and says "the business may be extended, and a future profit contingent largely upon the future growth of the city." "In fact, in the very near future, by the careful management of this property on the scale which we have adopted, and which we now believe in, this city can be managed without a cent of taxation upon its property, either municipal, State or county, out of the profit to be realized from this electric plant." This address has been circulated broadcast by the advocates of municipal ownership, and sounds very cheering to tax-payers. Last month the city had a chance to test the immense future profit made in their business enterprise. Their power is

† Abstract of a paper read June 19, before the Convention of Street Lighting Officials, New Haven, Conn.

water, and they built a dam under the supervision of two members of the City Council, installed wheels, dynamos, etc. The dam was not properly constructed, as the men in charge knew nothing about that kind of business. The natural result was the dam gave way, and swept everything out, making a dead loss of the whole affair, and the old plan has been abandoned, and $50,000 of the tax-payers' money is gone, and they have decided to continue the plan of levying taxes to raise money to meet this loss, and pay in addition $77.36 per year per lamp, which it is costing them with water-power.

Mr. Yerkes, one of the most prominent business men of Chicago, says: "We all know that there are no large industries in this city so poorly or extravagantly managed as those under the control of the city government. In our electric light department the plant of the city cost much more than it could have been built for by private companies. In fact the prices paid were most extravagant. The operation of the electric plant is to-day a disgrace to this community. There is money enough wasted to make a good dividend for a private company." I hold in my hand a copy of the report of the village trustees of Swanton, Vt., and on the sixteenth page of that report the following statement is made: "The trustees recommend that a tax on the grand list of 30 per cent. be laid, 15 per cent. to pay for street lighting, and the balance to pay for the running expenses of the village." That resolution or recommendation was adopted by the village, and the auditors certify that that report is correct.

We have a statement made by an advocate of municipal ownership and told that the cost of an arc-light is only $10 per year, while the taxpayers voted a tax of 30 per cent., 15 per cent. to pay for the electric lights, and 15 per cent. for all other expenses of the village. That is, the electric lights required half of the entire tax levied by the village, and as much as all the other departments, including sewers, streets, fire department, police and sidewalks. We will examine the account of the village of Swanton. They purchased a plant and water power, as their report, dated March, 1896, shows, for $42,-844.85. On the seventh page of this village report is a detailed account of the operating expenses of this electric plant, and not including interest, it amounted to $2,375.62. They are paying 5 per cent. interest, making $2,112.44 per year. Only calling the depreciation 5 per cent. on $26,000, a little over half of the investment, and we have $1300, making a total for the year of $5,817.86. Deduct from this $3502.05, total income produced by this investment as shown on page 8 of the same report, and we find the net cost to the village of 20 street lights is $2,315.81, being $115.79 per lamp per year, an increase in cost of $20.62 per lamp over the previous year. The above figures are taken from the official report, and the village auditors certify that the report is correct. Here we have the truth regarding the cost of light in the official report for the year 1895 of Bay City, Mich., showing salaries, fuel and miscellaneous $8900.-81; depreciation which they admit, $8630.57; total, $14,164.55. For burning 181 lamps, only running 2586 hours per year, and costing .0302 cents per hour, per year, this is the expense under municipal management. Jackson, Mich., same State, contracts with a private company for her light, and is furnished with 219 lamps for 3928 hours per year, at a cost of .0208 cents per hour. The article in the *Arena* on page 440 states that the total cost of production in Jamestown, N. Y., under complete public ownership is $32 per lamp per year.

The New York Telephone Company.

Regarding the absorption of the Metropolitan Telephone & Telegraph Company by the New York Telephone Company, we are informed that the Westchester Telephone Company is also included in the transfer. New York & New Jersey Telephone Company remains independent.

All the territory within New York State, within a radius of 33 miles from the New York City Hall (excepting Long Island and Staten Island) and the section of Connecticut coming within that radius, comprises the limits of the New York Company.

In organizing the New York Telephone Company the object was to consolidate the two companies and acquire increased capital for future extensions and for improvements in the existing service within the new company's territory.

Heartless Brevity.

The soulless editor of a Western paper thus chronicles a fatal accident to an unfortunate lineman: Mr. Will McCabe, while repairing the electric lights at Maquoketa, fell from the top of a pole and broke his neck and arms, besides receiving other injuries. Funeral service held Thursday.

The Transformation of the Energy of Carbon Into Other Available Forms.*

BY C. J. REED.

The energy of carbon, and hydrocarbons such as coal, is probably the most stable of all the forms of energy with which we are directly supplied by nature.

There are five general methods or processes known at present for converting this form of energy into the numerous forms that are directly available to man. They are: (1) The thermal method. (2) The thermo-dynamic method. (3) The thermo-electric method. (4) The thermo-magnetic method. (5) The thermo-chemical method

The simplest is the thermal method, in which, by simple combustion, the energy is converted directly into heat and light, and utilized for warming and illuminating.

The thermo-dynamic method consists in liberating the energy as heat by combustion, and subsequently converting the heat, through the agency of a heat-engine, into kintic energy.

The thermo-electric method consists in liberating the energy as heat by combustion, and subsequently converting the heat into electrical energy through the agency of a thermo-electric junction.

The thermo-magnetic method consists in first liberating the energy as heat, and subsequently employing the heat to alter the intensity of a magnetic field, producing either mechanical motion or an electric current.

The thermo-chemical method embraces two varieties, each of which consists of two distinct steps or operations. One of these varieties consists in liberating the energy as heat, and subsequently causing it to be absorbed as chemical energy by a secondary substance in an endothermic reaction. The other consists in transfering the molecular energy, without transformation, from the molecules of carbon or coal to the molecules of a secondary substance, where it is less stable and consequently more available. This transfer has been accomplished only at high temperatures, and therefore it requires the expenditure of some energy in the form of heat.

The second step which follows the thermo-chemical process consists in transforming the energy of the secondary substance into electrical energy through the agency of a galvanic cell.

It will be seen that all these known methods are thermal methods to a greater or less extent; that is, they all require the whole or a portion of the energy concerned to be transformed into heat in the process of becoming available.

Pure carbon manifests no affinity for any known substance at low temperatures. It may be made to combine with oxygen directly only at temperatures above 250° C. Indirectly, and by expending upon it the energy of powerful oxidizing agents, or the energy of an electric current, it may be slowly oxidized at low temperatures. But all attempts, without exception, to obtain energy from carbon at low temperatures have totally failed.

Numerous compounds of carbon, such as carbon monoxide and various hydrocarbons, are easily oxidized at low temperatures by powerful oxidizing agents; but such reactions have not evolved available energy.

In the thermo-electric method the efficiency of transformation, in addition to being limited by the second law of thermo-dynamics, it limited also to the difference between the Peltier effects at the hot and cold junctions divided by the Peltier effect at the hot junction, an expression which is in the same form as that for the maximum efficiency of a thermo-dynamic process.

Comparing these two methods, we have in the thermo-dynamic transformation

$$E = \frac{T - T'}{T}$$

in which T and T' represent respectively the absolute temperatures at which heat is received and rejected in a heat engine, E being the maximum efficiency.

In the thermo-electric transformation, we have, in addition to the above limitation, the further limitation

$$E = \frac{P - P'}{P}$$

in which E is the maximum efficiency, and P and P' represent respectively the Peltier effects at the hot and cold junctions of a thermo-electric battery. A thermo-electric circuit may be so chosen that the Peltier effect at the cold junction is zero, though this is not generally practicable. In that case the maximum efficiency would not be limited by this law to less than $P \div P$ or 100 per cent.

* Abstract of a paper read before the Franklin Institute, May 26, 1896.

Unfortunately there are other and more important limitations to this method than the theoretical ones. These are of so serious a nature that the thermo-electric method has not yet equaled, or even remotely approached in efficiency, the thermo-dynamic method.

Perhaps the greatest drawback to the thermo-electric method of transformation is the fact that there is no known substance that fulfils the requirements of a perfect working substance, even to a very small extent. A perfect thermo-electric substance must be a perfect conductor of electricity and a perfect non-conductor of heat. But we find in nature that all substances are either very poor conductors of electricity, or else very good conductors of heat. The result of this and other limitations is that no thermo-electric couple has yet been produced which can transform more than a small fraction of 1 per cent. of the heat applied to it into electrical energy.

All good conductors of electricity are also good conductors of heat. It is therefore impossible to gain any great advantage by choosing a substance with reference either to its thermal or to its electric conductivity; because any advantage that may be gained through increased electric conductivity will generally be counterbalanced by the loss through increased thermal conductivity.

For the same reason it is useless to attempt, with any given substance, to reduce the electrical resistance of the thermo-electric battery by increasing the cross-section of the conductors. Any such decrease in resistance will be counterbalanced by a proportionate increase in the loss through conduction of heat.

Again, we cannot gain any advantage in attempting to reduce the heat conduction by increasing the distance between H and C, since this would proportionately increase the internal resistance. Therefore the efficiency evidently cannot be materially increased by altering the form or dimensions of the elements composing the battery.

The thermo-electromotive force between the cold and hot junctions with every known couple is very small, ranging from $\frac{1}{1000}$ to $\frac{1}{1000000}$ volt for every degree of difference in temperature, and is proportional to this difference. But here, again, increasing the temperature of the hot junction, or diminishing the temperature of the cold junction, while it does increase the E. M. F., can result in no improvement in efficiency, since increasing the difference in temperature between the junctions increases, in the same ratio, the rate at which heat will pass by conduction from the hot to the cold junction, where it is rejected without undergoing any change except degradation of temperature.

Heat is continuously flowing from the hot to the cold junction, whether the circuit be open or closed. Therefore the condition of maximum efficiency of transformation in a thermo-electric battery is that in which the maximum current is flowing, or when the external resistance is zero. This must mean that we can attain maximum efficiency of transformation only when the battery is short-circuited and the current is entirely used in heating the battery itself, the same as though there were no transformation.

In view of these facts, it seems to me that there is little hope for any radical improvement in this method of transformation.

In the thermo-magnetic method of transformation the energy is first liberated as heat, and the heat used to vary the intensity of magnetization in a magnetic body, with the production of either mechanical motion or an electric current. This method was discovered by Thomson and Houston in 1879, and was communicated to the Franklin Institute at that time; but the results obtained by this method, up to the present time, are commercially insignificant. As the process depends entirely upon absorption and rejection of external heat, it is evidently limited by the second law of thermo-dynamics. No attempt has yet been made to apply this method in practice.

The thermo-chemical method of transformation is the only known method by which even a part of the energy of fuel may be brought into an available form without a primal degradation into heat. In this process energy may be *transferred*, without transformation, directly from the molecules of fuel to the molecules of a secondary substance in which it is less stable.

In carrying out this process it is necessary to develop as heat only so much energy as may be required to maintain the substances involved in the operation at the temperature at which the transfer takes place, unless the reaction is endothermic, in which case additional heat for absorption must be supplied.

If the reaction be exothermic, the heat required for maintaining the temperature may be derived from the reaction itself after this is once started. If it be endothermic, there must be liberated as heat, in addition to the amount necessary to maintain the proper temperature, an amount equal to that absorbed in the reaction. In this case a part of the transferred energy passes through the form of heat.

The general method of carrying out the thermo-chemical process is to heat the fuel in a closed chamber to a high temperature in contact with a chemical reagent capable of acting upon the fuel in such a manner as to absorb the energy. The only reagents heretofore employed for this purpose are oxides, and generally metallic oxides, which, in the reaction, become reduced to the metallic state by oxidizing the fuel.

The difference between the formation heat of the oxide employed and that of the oxide formed represents an amount of energy which must necessarily be developed in the form of heat, otherwise the reaction could not occur. If the formation heat of the oxide employed be greater than that of the oxide formed, the difference is negative, and must be supplied in the form of heat absorbed from an external source. If it be less the difference between the two is evolved as heat of combustion.

We find therefore two limitations to the efficiency of the thermo-chemical process: (1) The loss of the heat necessary to raise the materials to the temperature at which reaction takes place, and to maintain them at that temperature. (2) The heat necessarily evolved, and which is the equivalent of the difference between the formation heat of the reagent and that of the oxidation product. In cases where this latter heat is evolved by the reaction (this is, where the reaction is exothermic), it may generally be employed to help maintain the temperature. Where it is absorbed by the reaction (reaction endothermic), it must be obtained from without by the combustion of an additional amount of fuel. The result is that, in general, only exothermic reactions are easily and economically performed. It follows, also, that the more exothermic a reaction is, the more easily it will be maintained after starting. The more nearly athermal a reaction is, the greater will be the possible efficiency of the transfer from one substance to another, especially in cases where the reaction takes place at a low temperature.

(*To be continued.*)

The Effect of a Condenser.

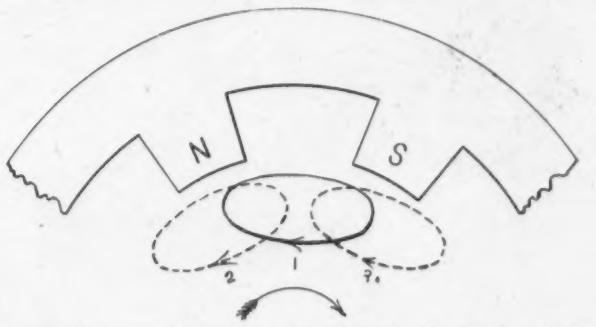
To the Editor of The Electrical World:

SIR:—The question whether the current leads 90 degrees or lags 270 degrees with respect to the impressed pressure wave is a matter which affects only a very short interval of time, represented by the exponential term of the alternating-current equation. The impedance term, which is the only term entering into most practical deductions, is not affected by this question. Consequently it seems to me that the question is rather an academic one than an engineering one. But, in any event, the 90-degree lead appears to be equally correct from both the engineering and academic standpoints.

UNIVERSITY OF WISCONSIN, MADISON, WIS. D. A. JACKSON.

To the Editor of The Electrical World:

SIR:—I would suggest that the condenser current be designated as a leading current of 90 degrees. A simple physical illustration makes such a conception easy to students. Consider an alternator, the armature coils of which turn as shown by the arrow. If the alternator be connected to a self-inductive device, the maximum of the inductance current will occur in the armature circuit 90 degrees



1. Position of coil for maximum induced E. M. F. to which lagging and leading currents are referred. 2. Position of coil with maximum capacity current. 3. Position of coil with maximum inductance current.

in phase after the coil has occupied the position of maximum E. M. F. producing this current. If the alternator now be connected to a condenser, the maximum of the capacity current will occur in the armature circuit when this circuit occupies the position with reference to the field of the alternator 90 degrees in advance of the position of maximum E. M. F. in the same direction as the condenser current through the coil. W. J. STANLEY.

PITTSFIELD, MASS.

THE ELECTRIC RAILWAY

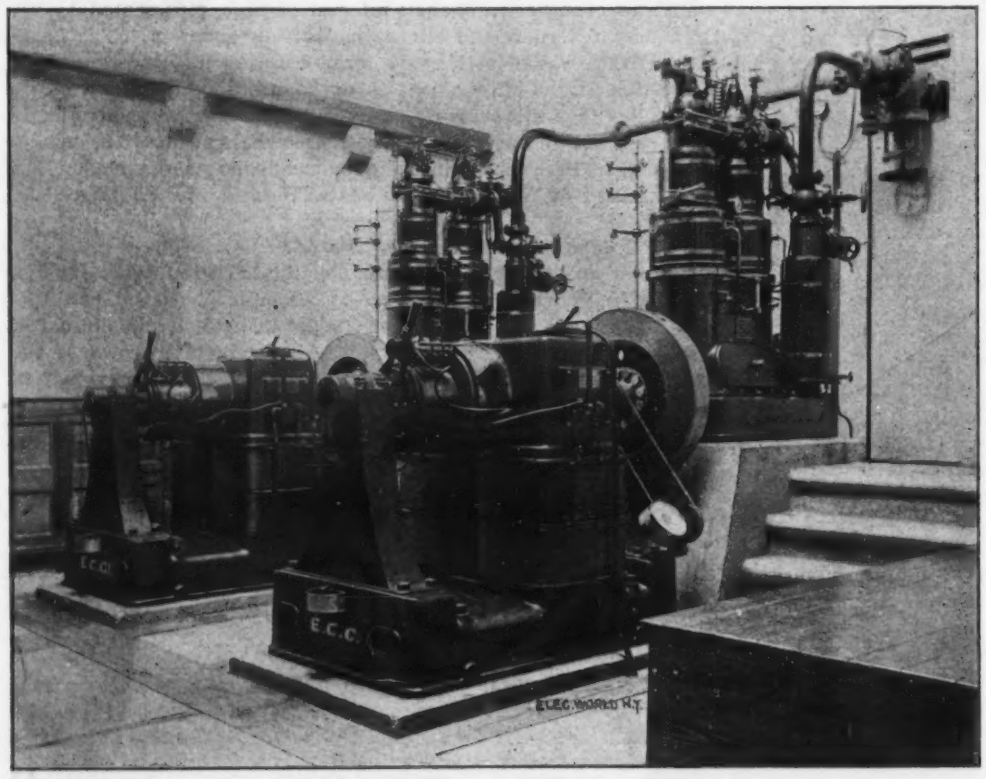
Hartlepool (England) Electric Railways.

BY ALBERT H. BRIDGE.

The Hartlepool railways which have just been equipped for electric-traction and which commenced running a few weeks ago were worked by steam until 1891, and after a lapse of several years the General Electric Tramways Company acquired the rights for the purpose of equipping the line on the overhead electric trolley system. The total length of the line is only two and one half miles, but it is interesting because it is a purely English system, nearly all our traction work up to the present having savored very considerably of American practice.

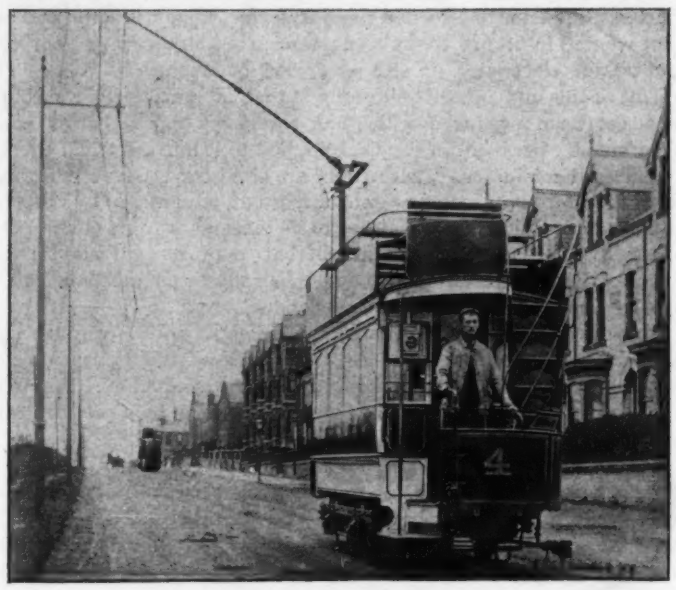
When the work was undertaken it was found to be necessary to repair the entire roadway by lifting the rails and embedding them in concrete and relaying the pavement. The track is single throughout, with 16 turnouts. It takes the centre of the roadway and has 65 girder rails. A 3-foot 6-inch gauge was decided upon and gradients and curves are unimportant.

The generating station is about half way down the line. The plant includes two Galloway boilers 20 feet long by 6 feet in diameter, capable of evaporating 3400 pounds of water per hour, and working at 140 pounds pressure. They are fed by a three-throw feed pump driven electrically, which has a 6-inch stroke 2-inch diameter, at 65 revolutions per minute, capable of delivering 700 gallons of water per hour. The boilers supply steam to two Willans 100 I. H. P. engines running at 450 revolutions per minute and provided with an automatic cut off. These engines are coupled direct to two dynamos having a normal output of 120 amperes at 500 volts, but they will carry 50 per cent, momentary excess current, and therefore are capable of checking the speed of the engine. As will be seen from the photograph, they have independent bed-plates and two bearings, and the shafts are coupled by bolts bushed with hard india-rubber, enclosed in brass tubes to deaden concussions transmitted from the engine. The dynamos being of the over type, the engines have been considerably elevated in order to bring the bearings into line, and for this purpose the floor at the end of the room where the engines stand is raised several feet. The armatures are wound on the Eickemeyer system and the magnets are compounded. Copper brushes are used and the commutators run sparkless at all loads. The commercial efficiency of the dynamos is 93 per cent. and the efficiency of the combined set about 84 per cent. One engine and dynamo suffice for the service of four cars, the second set being in reserve. Provision is made for a third set should a heavier service be demanded.



Direct-Coupled Engines and Generators.

An interesting feature in the general arrangement is the provision of an auxiliary plant, consisting of a secondary battery and dynamotor, driven from the generating dynamos. The cells are charged simultaneously with the working of the line while the load is light, but at moments of excessive demand the direction of the current is reversed, so that they supplement the current supplied to the car by the generating dynamos, and thus render the load less variable at the same time increasing the working capacity of the system, The arrangement also serves at 100 volts for driving the feed pump, lighting the station and moving the cars in the shed; and as the current from the accumulators is available at all hours, it is possible to run late or early cars without the aid of the engines.



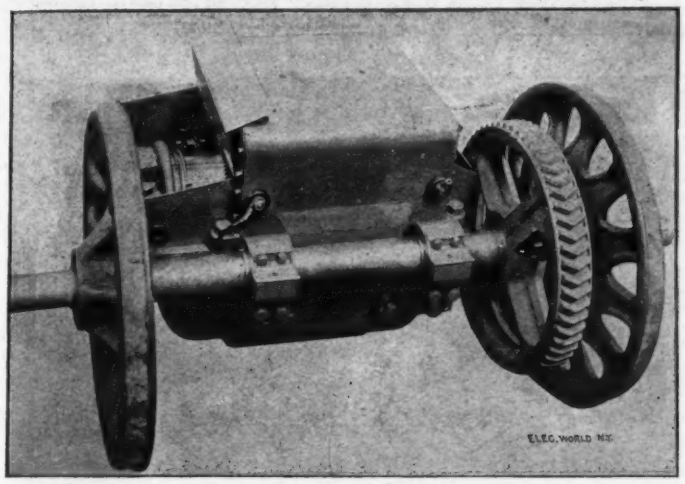
Car, Showing Side Trolley.

The dynamotor is of the improved type now being constructed by the Electric Construction Company, with a double-wound armature for 500 volts, 30 amperes and 130 volts. 85 amperes. It runs at 800 revolutions, and the efficiency of conversion is 85 per cent. The secondary battery consists of 53 E. P. S., 31 K-type cells.

The switchboard, which stands in the engine-room, is provided with single pole automatic cut-out switches for each circuit, and also with single-pole throw-over switches for each dynamo, thus serving to connect them with either of the two circuits into which the line is divided. On the other pole are placed fuses enclosed in glass tubes, with spring connections, enabling them to be instantaneously replaced. Dead-beat Weston ammeters are used on the line circuits, and E. C. C. ammeters on the dynamos. The voltmeters are Kelvin's electrostatic pattern, and suitable switches are provided for the transformers, lighting circuits, etc., the dynamos being provided with regulating resistances. Across the terminals of the automatic cut-outs are placed resistances to carry 60 amperes. These, when through excess of current the switches open, still permit half the normal current to pass into the line, racing of the engines and dislocation of the traffic due to complete cessation of current from transient causes being thus avoided. The sparking across the switches

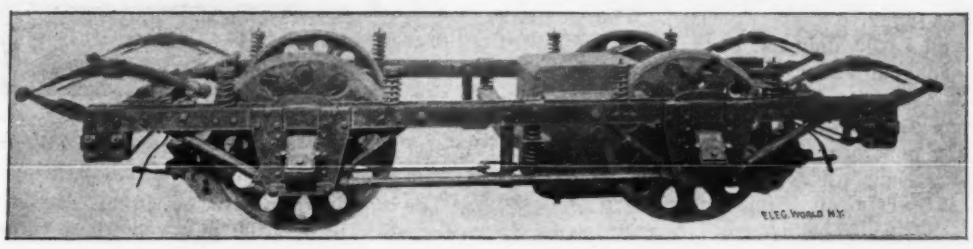
is, moreover, greatly reduced, and the attendants can with impunity close them to ascertain whether working can be continued, or whether permanent short circuit exists.

The general arrangement of the line is the same as on the South Staffordshire railways, being the side pole system as originally de-



CAR MOTOR.

signed by Mr. A. Dickinson, and adopted by the Electric Construction Company. The poles being placed at the side of the road, and there being no span wires, they cannot be said to have any objectionable appearance. No feeders are necessary on account of the advantageous position of the station, and the moderate length of the line; two trolley wires of No. o B. W G. suffice to carry the current. One of these wires takes the up and the other the down services, and they are cross-connected at two points, so as to supplement one another. One circuit takes the line on the side of Hartlepool, and the other on the side of West Hartlepool, sectional insulators being placed half way in either direction, so that in the event of an accident happening to either of the trolley wires, pressure can still be maintained on the other. The necessity of turn-out switches is done away with by using two wires, and this also simplifies the working. The length of the trolley pole arms varies from 4 to 12 feet. The height of the trolley wire above the line is 21 feet, except at two points where it is only 16 feet. This depression of the poles has caused no trouble in working, for the trolley wheel exhibits no tendency to leave the wire at these points. The insulators are of the Ætna type, the wires being clipped in long ears without soldering.



TYPE OF TRUCK.

The rails are used as an uninsulated earth return. Electrical continuity between the rail-joints is secured by means of duplicate bonds as well as by the fish-plates. The bonds consist of No. 4 B. W. G. copper wire wrapped round and soldered to the end of a taper iron stud which is driven hard into a rymered hole in the web of the rail, fixed by means of a nut and washer. The whole is then coated with tar and embedded in the roadway. The rails are connected from the points where they pass nearest the generating station to the switchboard by means of an insulated underground 19/12 B.W. G. cable, 50 yards long, and the line by four 19/15 cables drawn into iron pipes.

In accordance with the Board of Trade traction regulations, a recording voltmeter, a leakage indicator, and earth-plates are provided at the power station.

The cars, which were constructed by Messrs. G. F. Milnes & Co., measure 22 feet over all, and seat 38 passengers. The bodies are mounted on four-wheeled trucks, as shown. The wheel is 33 inches in diameter, and the wheel-base 5 feet 6 inches, and each car has one motor. The armatures are drum-wound with Eickemeyer coils, the cores being slotted and uninsulated. The whole of the insulation being in the coils, a defective coil is easily replaced.

The commutator has 72 sections. Two-pole, iron-clad, cast-steel motors entirely closing the armatures are used. Running at eight miles an hour, the speed of the motor is 360 revolutions. The gear wheels are cast-steel, with double teeth, helical and single reduction. The magnets are spring, suspended from the truck.

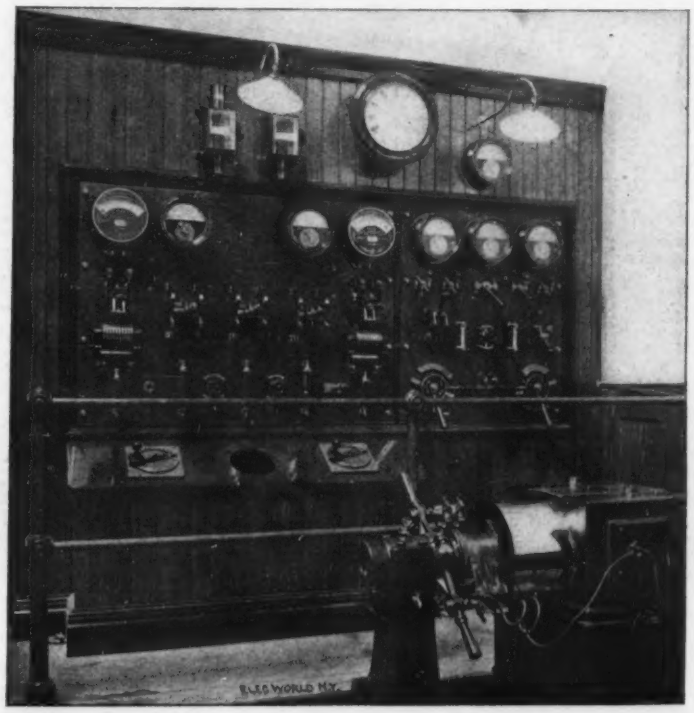
A fully loaded car weighs 7½ tons, and this is found to require about 12 amperes when running on level ground. The motor gives a maximum commercial efficiency of 83 per cent., and over 80 per cent. for a considerable range of speed. At a speed of eight miles per hour it develops ten horse-power.

Duplicate controlling gear has been supplied with the cars, one set at each end. The handle of the reversing switch is on the top of the controller. The resistance consists of 40 platinoid spirals sheathed with asbestos and contained in vertical brass tubes. This construction is claimed to possess the double advantage of giving support to the coils, and is capable of absorbing a large amount of heat for short periods. The tubes are insulated from one another by being let into slate bases, and the ends of the platinoid wires are led direct to the switch contacts, so that insulated connections are avoided. The switch has 21 points. The movable contact is made with an iron limb, and is wound with a coil carrying the current from the trolley; a traveling magnetic field is thus created which blows out the arc at every contact.

When the line current is cut off the motor is short circuited, and operating the reversing switch before the car stops converts it into a generator, thus braking the car. This arrangement takes the place of an emergency brake.

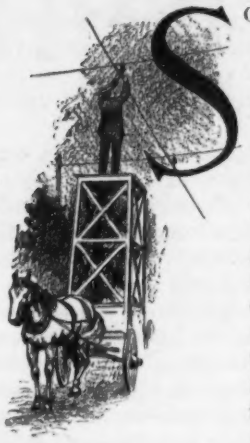
Shunt-Wound Railway Motors.

The firm of Siemens & Halske, Berlin, Germany, has for some time past used shunt-wound motors on cars, some of them being in regular use at Halle, Germany, and are giving perfect satisfaction. The superiority of the shunt motors in some respects has always been acknowledged, one of them being that they are capable of being controlled automatically, and another their property of being able to return power to the line on descending grades. They did not come into use before on account of certain inconveniences. In the present case no trouble whatever had been experienced, and no special protection was found necessary. When the circuit is broken the field magnets remain saturated for about 10 seconds, which is said to overcome the influence due to the field.



SWITCHBOARD.

Recent Improvements in the Albany Street-Railway Power-House.



SOME recent changes which have taken place in the Albany Street Railway power-house indicate certain advances in engineering which are not only interesting but worthy of study. A new generating set installed some three months ago, and which is doing good service, consists of an Allis-Corliss engine, direct-coupled to a Westinghouse multipolar generator. The generator, which runs at a speed of 80 revolutions per minute, has a field magnet consisting of 10 salient poles each wound with a rectangular shunt and series-coils the latter consisting of a single layer of a few turns of conductor wound on edge insulated with tape and fastened together at regular intervals with woven cotton cord. Only the corners of the shunt-coil are taped, the remainder being likewise overwound with cord. The fluctuation of load on the generator is comparatively slight and therefore it is not necessary to combine with the machine rapid regulating qualities, which are necessary with those of smaller types. The increased expense attached to the use of laminated pole-pieces is avoi ded by substituting instead cast iron, which forms a part of the main casting. The operation of the generator indicates that the design has been carefully and successfully carried out.

The armature weighs 43 tons and is 88 inches in diameter. It is mounted upon a 22-inch shaft, which is supported by two bearings which support besides a massive cast fly-wheel. The commutator is 15 inches wide and has a diameter of 6 feet, being belted to overhang the shaft and mounted on the armature spider. The generator is rated at 800 kilowatts, having a capacity of 1500 amperes at 550 volts pressure, the no-load voltage being 500 volts.

The field magnet of the generator is divided into two, top and bottom, as shown in Fig. 1, which gives a general view of the machine, a single bolt it will be noticed being sufficient to hold the magnetic joint together. The yoke which overhangs the pole-pieces on either side is faced up on the commutator side to receive a brace support, which is confined in a socket prepared for it, by a thin metal ring screwed in place. Worm gear teeth are cut in the base of the rocker and mesh into a worm on a horizontal rod, which in turn is driven by means of beveled gears by the wheel and rod shown in the figure. Flat flexible strips conduct the current from the flat copper strips and connect with the brush studs. No safety device is interposed between the generator and the switchboard, through which the current is directly conducted. The switchboarp is provided with the usual controlling apparatus, ammeter, voltmeter, rheostats, main switch and circuit-breaker.

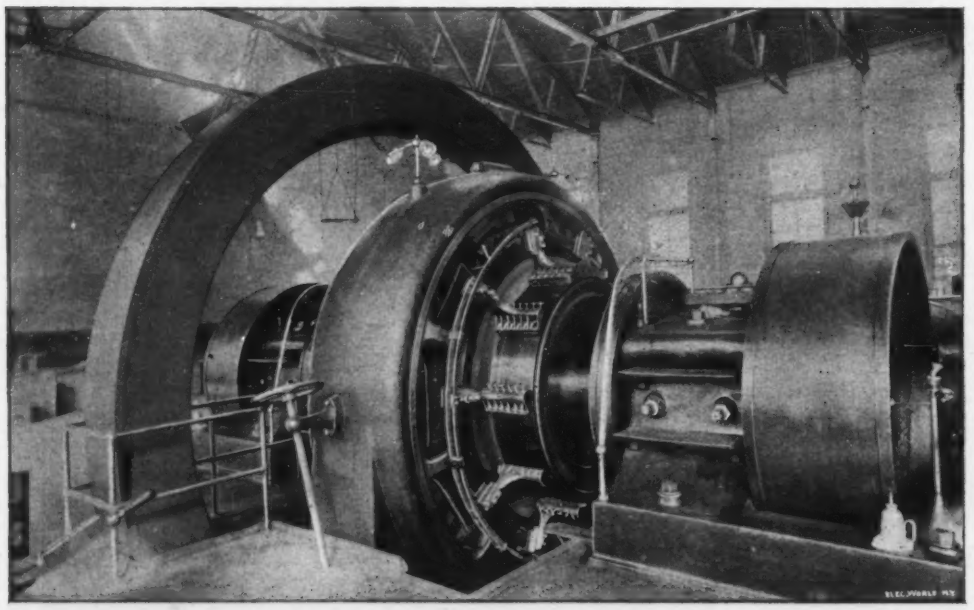


Fig. 1.—The Generator.

An Allis cross-compound slow-speed condensing engine rated at 1000 horse-power and built by the E. P. Allis Company, Milwaukee, Wis., is directly connected to the generator. It has a four-foot stroke and cylinders 26 and 50 inches in diameter respectively. The valve gear is the Reynolds modification of the Corliss crab claw. The cranks actuate crank discs on either side of the shaft, the high-pressure side being next to the generator.

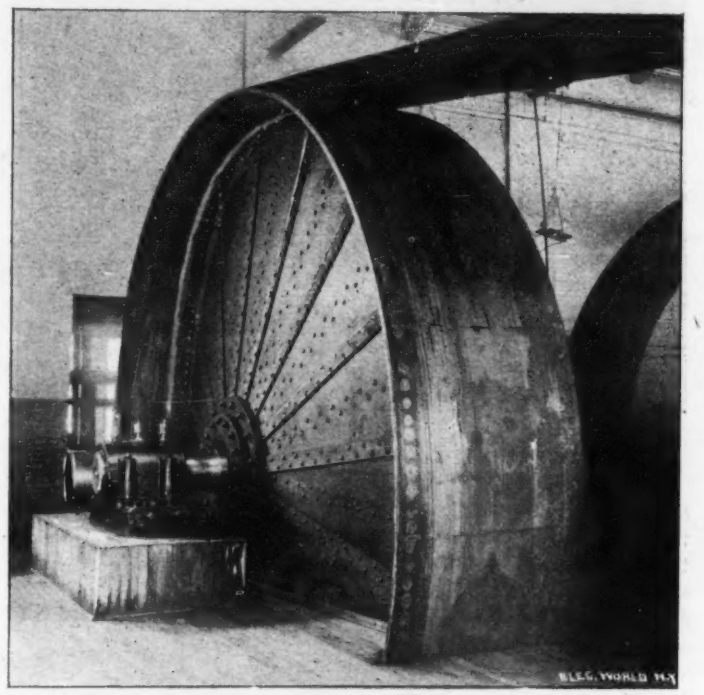


Fig. 3.—Disc Fly-Wheel.

The bursting of a fly-wheel in this station resulted in a sad accident still fresh in the minds of those interested in street railway matters. The Albany Railway Company has taken extraordinary precautions to avert a second catastrophe and consequently has fitted both the engine which was wrecked and its mate with disc fly-wheels made of mild steel, a description of which was recently given in our columns. The damaged engine has already been rebuilt and the fly-wheel fitted in place and has been running for the past three months in a satisfactory manner. Were it not for the slight protuberances on the face of the wheel's periphery, it would not be necessary to turn it up, but as it is the wheel is remarkably true. The factor of safety used is 26 when running at speed of 92 revolutions per minute. The wheels are guaranteed to stand a speed of 250 revolutions per minute and transmit over 650 horse-power by means of 48-inch belts. Fig. 3 shows the wheel as it appears in the station.

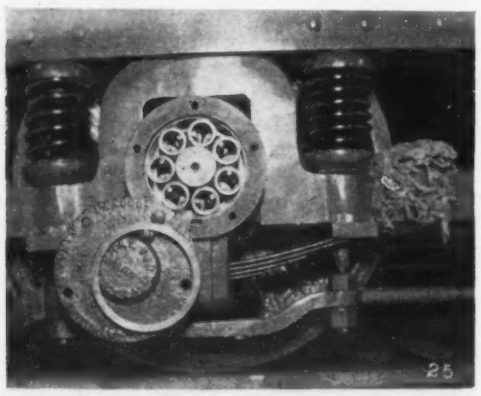


Fig. 2.—Meneely Tubular Bearings.

The Meneely tubular bearings have been in use now on the Albany Street Railway cars for nearly three years and have thus far stood the test of practice. The motor-men and other employees of the

company are enthusiastic in their praise, claiming that their use has reduced the station load nearly 40 per cent. The bearings have aequired little or no repairing since they have been in service, and when it is remembered that the old half-round axle brasses wear from six to eight months, the question of increased life, aside from all considerations of saving in power, is worthy of consideration. The chief objection to this bearing has been that by their use the car sills are raised noticeably higher. This, however, is not as bad as has been formerly represented. The 60 cars used on the Albany road are now fitted with these bearings and nothing else is being installed on the new equipments. There is no doubt that a bearing with a rolling contact must come sooner or later and the Meneely bearing seems to have a good start. They are mostly installed on the Taylor trucks, which are used on this road.

Return Circuits of Electric Railways.

In a paper read before the Franklin Institute, Mr. Charles Hewitt calls attention to the difficulties encountered by insufficient bonding and the electrolytic effects produced thereby on neighboring pipe systems. It was not until the larger cities began to adopt electric traction that the electrolysis of iron pipes began to show itself, and not until 1891 did this trouble take any definite shape. He says that he must confess that at the present time he is not able to answer the causes of electrolysis positively. One thing is certain, namely, that it takes place more rapidly in salty than in dry sandy soil. Copper return wires in dry sand have remained apparently unaffected for years, whereas similar wires buried in the soil of Salt Lake City will scarcely last three months. In the case of Erie much of the trouble was in water-pipes which were suspended in the air and showed the corrosion on the inside. It seems evident that moisture in some form is necessary to cause the trouble, and he believed that the most destructive element is nascent oxygen. It is stated in text-books that from 1.47 to 2 volts are required to decompose water, whereas, it has been proved conclusively by Prof. Jackson that a mere directive force is all that is necessary to cause electrolysis, and to his knowledge electrolysis has very rapidly taken place under a pressure of less than one volt. It is somewhat amusing at the present day to recall the fact that in the year 1887 earth and rail returns were considered as zero resistances, whereas, we know at the present time the rail return problem is one of quite as great importance as the feeder problem.

In considering the question we must look upon the rails and the pipes as two separate systems of conductors, which in their normal condition are slightly insulated from each other by a layer of earth. If, therefore, the track were of zero resistance and the insulation between the track and the pipes were of infinite resistance, it is very obvious that no current would leave the rails and enter the pipes. Unfortunately neither of the conditions can be perfectly realized. The electrolytic action takes place only at the anode of the positive pole; the region between the station and the neutral point may be called the "danger" area, and our sole concern is to protect the pipes in this region. In order to do this we must make the pipe negative to the rail at all points. Many engineers have recommended the connecting of the pipes and the rail return. He believes that there are advocates of this scheme, but to his mind the suggestion is utterly preposterous, since it simply aggravates the trouble by inviting currents to the pipes. To his mind it seemed just as reprehensible on the part of the railway company to appropriate the pipes of the water and gas companies as an annex to their system as it would be to appropriate the conductors of another electric company. He suggests that the position of the engineer should be not to invite the current into the pipe, but to take care of all that come in uninvited. In other words, to keep the pipes in the return system as distinct from each other as possible, and make the resistance of the track system as low as possible. Of the various devices suggested for overcoming the trouble, naturally the first is that of a perfect rail bond. A 60-pound rail has a cross-sectional area of 8.3 square inches, which at the ratio of 7 to 1, the ratio of the conductivity of iron to copper, would be equivalent to a conductor of 1,500,000 circular mils. He believes, however, that the true ratio of steel rails is nearer to 10 to 1, which would make the rail equivalent to a copper bar of 1,050,000 circular mils. When we realize that there are two rails in each track and that all ramifying tracks in a large city are connected together, we begin to realize the vast amount of electrical conductors the tracks represent. It is, therefore, injudicious to abandon the tracks as conductors. If the track be well bonded there is no necessity for an elaborate system of track feeders. On some of the small roads no track feeders whatsoever are necessary.

On the larger roads there are many places where the current density becomes so great that it is advisable to augment the track by the addition of a proper amount of copper; in fact, all track in the city should be protected by a smaller or greater amount of copper in order to guard against broken bonds as well as to provide a better conductor. He believes that it is advisable in all cases to protect the return cable with a moderate amount of insulation where such is used as a part of the return system. Perhaps the best suggestion which has been made for protecting the "danger" area is that in the paper of Prof. Farnham, read before the American Institute of Electrical Engineers. This consists of running one or more return feeders to all the pipes which show a potential positive to the track or return cables. This return feeder must have no direct connection with the other return feeders except at the negative bus-bar, and must be of sufficiently low resistance to bring the potential of the pipes at least down to that of the track at each point between the power-house and the "danger" point.

In one of our Eastern cities it has been stated that 5000 amperes of the 8000 output was returned by the pipe system.

Another plan is that of reducing the potential of the pipe below that of the rail, suggested by Mr. H. P. Brown, and consists of a plan of connecting the negative lead of one generator to the pipe system in the station and running this generator at a greater difference of potential between its leads than between the negative bus-bar. Mr. Brown claims to have made a reduction of some 300 horse-power in the Newark power-station. This plan Mr. Hewitt considers radically at fault, for even taking no account of the difficulties of running a special generator for this purpose, it is self-evident that all the current generated must be returned through the pipes. The complications necessary for using the double ground on the generators or of giving up one generator for this special purpose, or even of installing a separate machine to do this work, will be apparent to every one. Mr. Hewitt favors a modification of the plan, which may be called an "inverted booster." Assuming that we have a separate set of pipe return feeders, and that in this feeder, before attaching it to the negative bus-bar, we place a series dynamo which will have a current capacity equal to the amount of current returned by the pipe and a potential only sufficient to overcome the maximum difference of potential between the pipes and the tracks, this generator will have a tendency then to lower the potential of the pipes below that of the negative bus-bar, and being of very low potential need only be a very small machine.

Overcrowding of Electric Cars in Brooklyn.

The frequent accidents of late on some of the Brooklyn trolley lines have had the effect of bringing about stringent measures for their prevention. The greatest cause of complaint is the dangerous overcrowding of the cars, and the city police officials have taken up the subject in earnest with the intention of rigorously enforcing the laws applying to such cases. The presidents of the various railway companies have been notified of this determination, and President A. L. Johnson, of the Nassau Railway Company, has promised to do everything in his power to abate the evil complained of and bring about the desired result.

In furtherance of this object he has caused to be posted in the various depots of the company a notice, of which the following is a copy:

NOTICE TO MOTORMEN AND CONDUCTORS.

"Your attention is hereby called to Section 4 of the city ordinance passed April 1, 1895, which reads as follows: 'No railroad company operating cars by electricity upon any of the streets, avenues, or public places of the City of Brooklyn for the purpose of carrying passengers shall carry more passengers than 50 per cent. more than its seating capacity.'

"'Special instructions have been given to members of the force to compel the observance of the above ordinance. George Crosby, Deputy Commissioner.'

"You will on no occasion allow any one to ride on the inside step of an open car, and should they refuse to get off, stop the car, and have it stand until such person is removed from the inside step. Ten (10) seat open cars, will comfortably seat fifty (50) or sixty (60) people, and therefore you should at no time take to exceed 75 to 90 people on your car at one time Do all in your power to accomplish this result, but never use any violence or force. By order of

"A. L. JOHNSON, *President*."

Policemen will be stationed at all trolley line terminals and transfer points to prevent overcrowding.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternate-Current Motor. DAVIES system. Lond. *Elec.*, June 19; a long illustrated description of this motor, including a number of diagrams.—It is thought that a material advance has been made in this motor, although it does not appear to overcome the difficulty of a low power factor; the improvements in the starting torque and efficiency are marked, making the motor quite suitable for purposes in which an idle current is no serious objection. The improvements refer chiefly to a method by which a single-phase current is made to produce a rotary field for starting and also suitable for a transformer, the function of which is to transform a single-phase current into two approximately equal currents differing in phase; means are described for giving the greatest possible starting moment and the greatest possible efficiency in a transformer by maintaining the rotating magnetic field at constant strength and causing it to revolve as nearly as possible uniformly. It is not practical at present to split a single-phase current into two differing by 90 degrees, but it is comparatively easy for 45 degrees; if such a split current passes through two coils at right angles with each other, the resulting rotating field will not be uniform; in the present method the two axes of the field windings are inclined to each other at an angle which is the supplement of the phase angle, which latter is 45 degrees, thus making a magnetic field of constant magnitude and of a constant angular advance. He found it impossible to distribute the magnetic field in the motors as usually constructed with a squirrel cage armature and small air gap, the field being densest near the winding in the iron cores; in the present form the windings are distributed so as to compensate for the varying reluctances of the central space; the conditions to be complied with are given; the parts of each coil are wound on the inside surface of the field in planes parallel to each other, that is, starting in two equal diametrically opposite holes they gradually become smaller, the last turns being in two adjacent holes. External views of the motors and parts of it are given; there is also a favorable report by Prof. S. P. Thompson, in which he says that they "attain advantages hitherto only fully realized by two-phase and three-phase systems of currents"; he tested a four-pole machine weighing 125 pounds giving 0.75 brake-horse-power, and a small two-pole machine giving one sixteenth horse-power; the tabulated results of the first are given showing an efficiency up to 96.9 per cent. for medium load and a power factor varying from 0.19 to 0.47 at full load, but no comment is made on this in the report; the slip of the field, running light, was only 16 revolutions out of 2568 and at two thirds load it was only 5.5 per cent.; the efficiency was even better than that of continuous-current motors of the same dimensions; the starting torque, although not as much as for continuous-current motors, was sufficient for most purposes; it is thought that better results as to the power factor are possible.

Graphical Theory of Multiphase Motors. BLONDEL. *Elek. Zeit.*, June 11.—A translation in German of the French article noticed in the *Digest*, March 21.

Phenomena of Commutator Resistance. EDSALL and RORTY. *Sibley Jour.*, June; abstract of a thesis.—They show the importance of an investigation of this subject, as the resistance losses at the commutator of any machine will average 0.8 watt per ampere for metallic brushes and 2 to 4 watts for carbon brushes; they refer to the tests of Cox and Buck (see *Digest*, Aug. 24, 1895) who however entirely neglected the effect of varying current density, which is the point to which the present writers devote their attention. They give the results of experiments, which are briefly described, and were carried out for metallic and for carbon brushes; the resistance curves obtained are both hyperbolas, the one for metallic brushes being equilateral; the watt curves are also given; the fall of voltage was found to be independent of the current for metallic brushes and nearly so for carbon brushes; in many cases with metallic brushes the fall of potential was greater for very small currents than for large ones, which they explain with the assumption that the coating which forms on the commutator surface is practically a non-conductor and that each current tears it apart to a different degree; by gradually increasing the current there was a sudden transition after which the limiting condition of a nearly constant fall was reached. Tests were also made to determine the effect of speed and brush pressure, and these seem to show that mere changes in the velocity had little or no effect; there was a decrease in the loss with an increase in the pressure with metallic brushes, as also with carbon brushes, and they conclude that an increase of pressure within the usual working limits is not an important factor in determining the contact resistance. Their results are briefly as follows: The mere change in velocity has no effect on the resistance; within ordinary working limits an increase of brush pressure causes only a slight decrease of resistance; sandpaper used occasionally will greatly reduce the loss; oil used with metallic brushes materially reduces the resistance, but the effect is only temporary; both carbon and metallic brushes tend to reach a limiting condition in which the resistance varies inversely as the current. They develop an approximate formula for the total commutator losses.

Method of Obtaining Different Kinds of Currents. PATTEN. *Amer. Electrician*, June.—An illustrated article describing the well-known, cheap and simple way for obtaining different kinds of currents for experimental work; several contact rings are secured on the commutator of an ordinary machine and are connected to various bars, and from these alternating currents of various phase differences can be obtained.

Methods of Starting Induction Motors. HELDT. *Amer. Electrician*, June.—A brief, illustrated article of an elementary character.

LIGHTS AND LIGHTING.

Public Arc Lighting on Motor-Generator and Converter Systems. Lond. *Elec. Rev.*, June 19.—A short article referring briefly to the systems in use, more particularly to the one suggested by McLean and used at Oxford, where high-tension continuous-currents are employed. At first 16 lamps were tried, which number has now been doubled; the lamps are run 20 in series across high-tension 1000-volt omnibus bars, the remaining 12 being connected two in series across the 100-volt low-tension mains; 24 are extinguished at midnight, a couple of 16-cp incandescent lamps carried by supplementary brackets on the columns, being switched on; the other eight lamps run all night. An automatic switch was devised for cutting out the arcs and incandescents at daybreak; it consists of a tumbler-switch operated by an electromagnet under the control of a clock wound up daily by the lamp trimmers, and set to the time when the lamps are to be switched off. At Portsmouth, where arcs and incandescents are also used, the change is effected by a polarized switch operated by reversing the rectified current.

POWER AND HEAT.

Electric Plow. West. Elec., July 4.—An illustrated description of the Hogeland machine, a trial of which was recently made and reported to be entirely successful. It has two driving wheels and two guide wheels; it is provided with a 5-hp 500-volt motor, the current being supplied through a twisted flexible wire which is carried on a reel from which it is paid out as the plow moves in one direction, and wound up again automatically when moving in the other direction; in ordinary soil it is said that it can be operated at the rate of four or five miles an hour.

TRACTION.

Compressed-Air Traction. Elek. Zeit., June 11; an editorial discussing the subject in view of its being a possible competitor of electric traction.—The advantages of the electric transmission of power of all sorts are chiefly the lower first cost and the far higher efficiency; if this is the case with stationary motors, in which field compressed air has poor prospects, it may also be assumed at the start that for movable motors such as on cars, the probability of compressed air being a formidable competitor of electricity is not great; at present it is suggested to supply the car with charges of compressed air at every stopping point, a system which is analogous to the electric accumulator system, except that in the latter the charge requires hours, while within the former it takes but a few minutes, which is an advantage in its favor, but which no longer exists when compared with accumulator cars, in which the accumulators are changed after every trip, or in the mixed system used in Hanover; the compressed air system has very great disadvantages, which was shown very decidedly in the trial line in Paris; in this there are two feeding pipes 1.2 and 2.4 miles long; the losses due to leakage in the pipes and the maintenance of the pipes were so great that apart from the intrinsic low efficiency of the system, its application on a large scale does not appear possible; the compressed air reservoirs weigh nearly three tons, which is at least as much as an electric accumulator sufficient for running a much greater distance, and the air engines are heavier than the motors, their operation being also far more complicated; the two latter objections, it is thought, are not likely to be overcome. A brief description of the Popp-Conti system taken from the London *Engineer* is given referring to an experimental line in St. Quentin, in France, 4.8 miles long, which is to be opened in July; one of the chief features is that at each point where the car stops to take on passen-

gers, or at every second point, the reservoirs are filled with compressed air by means of an underground apparatus which is automatic in its action and ingenious, but appears rather complicated, and it is thought that it will not be found practical; considerable compressed air will probably be lost during the operation of charging and the cost of maintenance of the complicated machinery will probably be very high; but even if these objections are overcome the principal objection still exists, namely, that the efficiency of the transmission of compressed air can only be very low; the inventor intends to increase it by carrying a stove on the car for reheating the compressed air, but this application is thought to be attended with great objections. It is concluded that one need not consider compressed air as a formidable competitor of electricity, but its introduction for traction will aid in doing away with horses, and after this change has once been made a change back to horses would not be tolerated, thus opening the field for electricity.

Future of Electricity for Railway Work. DUNCAN. *Jour. Frank. Inst.*, June; a reprint in full of a lecture delivered before that Institute in January.—The lecture is quite long and should be read in its entirety to be fully appreciated; only a few general features can be given here. He refers briefly to his former paper on this subject read before the A. I. E. E. last year; he discusses the question whether our present method is the result of characteristics of the steam locomotive, or whether it is a natural system which is not greatly affected by the particular power used; he discusses the question of freight traffic, showing that in this country it is two or three times greater in gross value than the passenger traffic and as a rule pays much better; if freight lines are to be operated by electricity, smaller trains must be used or the electricity generated on the train; in the former case certain expense, depending on the number of trains, increases. The ideal local service would consist of a system owning tracks in the different towns which it connects, thus giving terminal facilities measured in square miles instead of square feet; electricity offers ideal conditions for ordinary express service as also for local traffic; the limit of speed that might be obtained can hardly be fixed; power can be obtained on a train making 120 or even 150 miles an hour possible, the air resistance being comparatively less than with steam engines, but by using more units the air resistance is increased; with a perfect roadbed and properly designed motors, 100 miles an hour may be made with great safety; the economy of the electric service for freight is very questionable; for local traffic it is ideal and for express traffic it is also ideal within a distance of a few hundred miles; the present custom of using heavy trains at long intervals gives the maximum economy for steam locomotives, and requires a minimum investment in tracks; to accomplish the same service by electricity an extra pair of tracks must be constructed for express work, thus requiring extra investment in tracks and a greater investment in motive power; it promises a cheaper and more satisfactory local and express service. He then considers what he believes will or may be in the not very distant future; local traffic must soon be absorbed by electric lines; the ratio of weight of passenger to dead weight is much greater in electric than in steam transportation and the motive power is cheaper; the greater part of the local freight transportation from suburbs into cities will be done by electricity; he quotes at length from an article in the New York *Evening Post*, showing that such systems are inside the limit of prophecy. Referring to the numerous schemes proposed for lines from New York to Philadelphia and Washington, he states that there is nothing "wild cat" about the matter but that practical difficulties will be encountered. It is doubtful whether the increased earnings would pay for the great expense; existing roads could establish such a service at much less expense than independent companies. He thinks the safety of the electric service would be greater than with our present system; the local or express service in the direction which he sketched out would be entirely different; the local service would employ a cheap and comparatively light roadbed, while for express trains a more expensive structure than that of the present steam roadways would be required; for freight service the equipment will differ widely from that of either local or express service. In conclusion he makes the statement that we will probably see a comprehensive adoption of electricity on some of our great systems and that some of us will live to see the time when the steam locomotives will be considered a curiosity.

Testing the Drop Around Rail Joints. SHEBLE. *Elec. Ry. Gaz.*, June 25.—He emphasizes the importance of good rail joints, showing that to equal the resistance of a 90-pound rail requires a copper rod 1.25 inches in diameter, and that it is a mistaken idea to suppose that the fish-plates carry much current around the joints; he then proposes simple methods for testing the drop around rail joints and for finding poor connections. A low-reading voltmeter or a high-reading one with the usual third binding post is used; the current flowing through the joint can be approximated by knowing the number of cars beyond the joint, if there is no other means of return than through the track; a car can be braked beyond the joint and the current measured more accurately; the total return drop was measured by him some years ago by using a telephone circuit as a potential wire. He publishes a table prepared by Harrington showing the current flowing through a number of different sizes of girder rails, for a given drop in potential based on 100 amperes flowing through 29 feet of 60-pound girder rail causing a drop of 1.0537 volts; this latter was determined by drilling holes in the girder and filling them with mercury for the purpose of making connections. The methods of testing the drop on rails are not described in detail, the main object of his article being to call the attention of managers to the importance of looking more closely into the return circuits.

Resistance Detector for Rail Joints. HENRY system. *Elec. Eng.*, July 1.—A brief, illustrated description of this apparatus for finding the condition of joints; with it several miles of road may be examined in a day; the instrument is a differential ammeter, whose coils are connected with flexible conductors to the track; the tests are made when the cars are running; a portion of the current from the track is shunted through the instrument; if the conductivity of both rails is alike the needle will remain at zero, but should there be a poor joint on one side the pointer will be deflected toward the bad joint (it is not stated what will happen if there is a poor joint on both rails, presumably because this is probably a rare case.)

Nantasket Beach Road. Elec. Eng., July 1.—An illustrated description of the third-rail system which is now being tried on that road; the rail is shaped somewhat like the letter A and is placed between the tracks; being supported in 30-foot sections, on three ash blocks to a section, these blocks having been boiled in a tar compound in vacuum; the insulation is said to be almost perfect; the third rail weighs 93 pounds to the yard, there are two sliding shoes on each car suspended from the trucks; there is no third rail over crossings, one of the shoes being always in contact with the rail for crossings less than 30 feet wide. The baggage cars used last year equipped with four motors have been abandoned and the large open cars are now exclusively used, of which 16 are to be put into service, each equipped with two motors. Two steam locomotives each burn four tons of coal a day, while not more than four tons are burned in the power house to operate the whole seven miles of electric line; during a recent test a speed of 70 to 80 miles an hour was attained.

Electricity on Steam Roads. Elec. Rev., July 1.—A statement that a contract is being considered by the N. Y., N. H. & H. R. R. to equip many of its branch lines with electricity, which, if carried out, will be the largest deal in electric railway apparatus ever consummated; this is based on the success of the Nantasket Beach road.

Mining Locomotive. Elec. Rev., July 1.—A short, descriptive article from the *Railroad Gazette* with an illustration; it refers to the 200-hp Baldwin-Westinghouse electric locomotive which has now been in operation for some weeks, and is said to be the largest mining locomotive ever built; the general dimensions and specifications are given; it has six wheels, weighs about 43,000 pounds and is guaranteed to haul 40 cars up a 3 per cent. grade at six miles an hour, developing a draw-bar pull of 10,000 pounds; the gauge is three feet.

Lake Street Elevated Road in Chicago. West. Elec., June 27.—A brief description of the electrical operation of this road.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Extension to Outlying Districts. GIBBINGS. Lond. *Elec. Eng.*, June 19; a reprint of a paper read at the meeting of the Municipal Electrical Association.—He discusses the subject under the headings of the cost of extending the supply, the effects on the cost of production and on the revenue, and the advisability of extensions, including a few tables; it is chiefly of local interest; one of the tables gives figures for estimating the maximum number of lights likely to be required by different kinds of consumers. He shows that the number of units consumed for a given maximum demand is very much greater in the outlying districts than in the centre of the town; in other words, private houses and small shops use the light for a greater number of hours than business offices and large shops; he gives the number of units sold per 8-cp lamp in different cities varying from about 11 in Hull to 22 in Bristol, and showing an average of 1 hour and 33 minutes, which means that the total capacity of a station is used for only this length of time per day in producing the satisfactory results obtained; with the aid of the private consumer this plant may be increased to 3 hours and 18 minutes, or more than two-fold, from which he concludes that the earning value of every lamp in the outlying districts is three times as great as that of one in the centre of the town, such a supply is therefore eminently desirable; he thinks that such extensions open up the possibility of a substantial reduction in the price and that they will be very remunerative. In the discussion the president (Mr. Wright) stated among other things that there is no use canvassing districts before the mains are down, the mains themselves being the best canvassers; he agreed with the author as to the importance of the private house load; Mr. Dixon also advocated laying the cable and letting it advertise itself; in Bradford they adopted the opposite policy, which amounted to nothing, but as soon as the cable had been laid the applications came in faster than they could deal with them; Mr. Mountain stated that the lamps in the residential district did not bring in as much as the shops, yet it was the only portion at the present time that was paying.

Lightning Arresters. Elec. Zeit., June 18.—Some time ago it was suggested by that journal that information be gathered from all sources regarding experience with lightning arresters; the present article is a reprint of the communications received from a few sources; most of them, however, discuss the theory or describe particular apparatus, there

being only a few references to data obtained in actual practice. A society in Hanover states that experience has shown that overhead telegraph and telephone lines in cities diminish and prevent strokes of lightning; overhead power and light lines ought therefore to be protected in a similar way, with numerous lightning arresters. In the case of a lightning discharge the current is not a single discharge, but an oscillating one with a frequency which is surely higher than 10^6; the advantages of self-induction coils are pointed out, and it is stated that from numerous experiments it is shown that a coil of 20 windings is sufficient to weaken very strong condenser discharges having a sparking distance of four cm, so much that the remaining action is scarcely felt by the human body; the chief requirement of an apparatus is that the plate arresters should perform their function reliably, which, however, experience shows they do not do. A society in Munich gives the experience at two stations in which the Siemens & Halske apparatus are used; in both of these lightning discharges were often noticed, but the apparatus acted in every case and completely protected the machine and lines. A society in Dresden sent a communication describing a simple form of arrester, consisting of a strip of mirror glass, which is scratched transversely on the silvered side with numerous lines, forming brakes, their number being dependent on the voltage of the line; two of these are mounted in parallel, one end being connected to the line and the other to the earth; a lightning discharge will pass over this, but the dynamo current cannot follow, as the sum of all the small air gaps is too great for the direct current of the machine. Another apparatus is described in which an electromagnet opens a circuit, the current passing through the switch, and thence in parallel through the magnet and a carbon shunt to earth; the apparatus sets itself. In a communication by Marcher he discusses at some length the theory and gives the results of some laboratory experiments; he shows that a single apparatus cannot sufficiently protect an installation; in the first set of experiments he tried two different kinds of lightning arresters, one made of a pile of discs of carbon separated by paraffined paper, and the other of a pile of zinc plates separated by mica; these were connected in parallel across spark gaps and it was found that for equal spark gaps the discharge began in the former; a transformer was used as the source of the discharge; at 10,000 to 20,000 volts the arresters were destroyed; when a large Geissler tube was connected in parallel to this the discharge was the same for a 70 times greater spark gap; when the transformer was operated by a momentary continuous current the tube was less effective than the other apparatus; this shows that for oscillating discharges the Geissler tube operates well, but for an explosive discharge it does not; he suggests that such tubes be filled with rarefied hydrochloric acid gas. The next set of experiments was intended to find whether an induction coil was a positive protection, but the experiments were not a success, but from very numerous practical results it may be safely assumed that an induction coil forms a barrier to such currents. His experiments showed that apparatus should be protected from atmospheric discharges in different ways according to the nature of the discharge, that is that a protective device must consist of several parts, one of which should take care of discharges like those from a condenser, which may be lead off through a spark gap, and for this purpose Geissler tubes are very suitable; it should also include a device for taking care of discharges, such as from bolts of lightning, which are such that the first described apparatus cannot lead them off to the earth; for this purpose an induction coil and an apparatus for extinguishing the flame are suitable; it should also contain an electrostatic screen; such an apparatus is described and illustrated. A society at Leipzig reports that plate arresters are absolutely unsuitable; favorable results have been obtained with several forms of apparatus containing multiple spark gaps on automatic spark extinguishers; experiences showing which of these apparatus is the best, have not been had; the question must be considered as unsolved.

Hanover. Elek. Zeit., June 11.—A brief, tabulated statement of the output, cost and profit of this station for the past five years.

Charging for Current. Gilchrist. *Elec. Eng.*, July 1.—A discussion of the subject with special reference to the suggestions of Farnsworth (see *Digest*, June 13, see also June 27), with whom he agrees as to the importance of some systematic basis of charging for customers of different classes; he criticises the suggestions, showing that it would be somewhat unsatisfactory in starting deals with a customer, as one could not make definite statements as to the exact charges, in advance; the consumption of a customer might vary so much that he would be constantly changing from one class to another; the cost of supervision he thinks would hardly justify the results. He gives an outline of the method which he uses, but the description is not quite clear; he suggests that customers who are glaringly unprofitable, referring chiefly to those which take a large amount of current at irregular periods, should be taken care of by a guarantee of a certain minimum income to the company, representing a fair interest on the company's investment which is necessary to be ready to supply him; the success with accumulators is being watched with great interest, as it offers possibilities of greatly increased economy.

WIRES, WIRING AND CONDUITS.

Loss of Voltage in Three-Phase Circuits. Heyland. *Elek. Zeit.*, June 11.—He refers to a recent article of Rasch (see *Digest*, June 20) in which that author came to the conclusion that, other things being the same, the loss in voltage for the triangular system is less than for the star system; he shows that in one of the figures one of the current should have been taken in the opposite direction, from which it follows that the loss in voltage is precisely the same for both of the systems; this refers to the currents in the feeders; for an equal voltage per branch circuit, which is the case treated by Rasch, "the voltage at the dynamo for the star system increases as the square root of three and the loss of voltage for the triangle system does not become smaller, but is inversely proportional to the square of the voltage, being therefore three times as great"; he shows that the loss of voltage in the triangle system "is for equal voltage at the branch, three times that with the star system"; a star system with a neutral wire is to the triangle system as the three-wire system with continuous currents and neutral wire is to the two-wire system; the use of the triangle system with neutral wire should be considered when there is no transformation, and only in the transformer systems should the triangle system be preferred, chiefly because the fourth neutral wire is not required and because the loss of voltage in the feeders then is not considered.

Installations in Damp and Swampy Districts. Pflaumer. *Elek. Zeit.*, June 11.—A brief description of the experience gained in Mantua and other cities in the northern part of Italy in damp, swampy districts; the results do not appear to differ greatly from those reached and well known in this country. Among other things he states that flexible cords should be used as little as possible; on walls liable to be damp, saltpetre is liable to be formed, and therefore in such places only rubber-covered wire should be used, great care being taken that in no place does the wire touch the walls; all switches and like apparatus should be made of material which is proof against moisture and fire, and should at least be mounted on such material; lamps should be protected in small groups by fuses, preferably allowing no more than three lamps to a fuse; large metallic fixtures, which are liable to become damp, should be insulated.

Apparatus for Indoor Wiring. Uppenborn. *Elek. Zeit.*, June 11.—A short article, containing numerous illustrations describing recent improvements in the apparatus of the firm of Hartman & Braun, in which twisted wires pass through split insulators, which are held near the wall by suitable curved hook supports.

ELECTRO-PHYSICS AND MAGNETISM.

Cathode Rays Under the Influence of Strong Magnetic Forces. Birkeland. Lond. *Elec. Rev.*, June 19; a continuation of the translation in abstract of his article (see *Digest*, last week).—Some of his experiments seem to show how the length of the parallel spark gap can be increased by the continued action of the magnet, by which means the Crookes tube can in a short time be converted into an excellent Röntgen tube; the electromagnet is placed in the same axis with a pear-shaped tube, opposite the cathode end, from which it is screened by an ebonite plate; when energized, the luminous phenomena are quite different; in the immediate neighborhood of the magnet the cathode light is nearly white, while further off it is green; a luminous cone is formed from the divergence of the cathode rays, terminating at the opposite end in a ring bounded by two concentric circles; when another magnet is placed opposite the further end the luminous ring disappears and a shadow of the cross is produced, as when there is no magnetic field. If the tube is continued in action for some time, while under the action of the magnet, the rarefaction increases in an extraordinary degree, the parallel spark length increasing in some cases from 1.5 to 75 mm; in moving the magnet away from the tube, there seems to be a critical point at which the parallel spark length increases very greatly and at this point the luminous phenomena change their character; when the tube is not in use, after this treatment, the parallel spark length falls in the course of several days to its original value; if immediately after the magnet ceases to act, electric discharges are sent through the tube in the opposite direction the spark length falls to its original value; this and other facts point to the conclusion that the parallel spark length does not depend on the vacuum, but probably on the quantity of gas occluded in the cathode; while pumping out a Röntgen tube he found that it is by no means in a good condition when the vacuum was obtained by uninterrupted pumping; if discharges are sent through it during the pumping operation, and always in the same direction, the spark gap will rise, but by reversing the current it will fall again; from this he concludes that it is very probable that the controlling factor for the parallel spark length is the gas occluded by the cathode; some of his experiments, however, appear to conflict with this assumption; under certain conditions the spark length rose and remained unchanged, even when the direction of the discharges was reversed; the experiments tend to show that the occluded gases under the action of the magnet and of the discharges undergo considerable changes; tubes having reached a great spark length retain this increased spark length given them by the magnet for a long time, and, in fact, do not seem ever to return to their original spark length; tubes with a relatively high pressure, such as Geissler tubes, undergo hardly any change in their spark length under the action of the magnet, but they develop cathode rays in abundance, even though they are not able to produce the green phosphorescence on the glass. The fact that cathode rays are drawn toward the magnetic pole he considers of interest in connection with the theory of the Aurora Borealis; from the above experiments it may be assumed that the rays

are attracted by the earth's magnetic pole, and that in some way or other the energy is derived from the sun.

Concentration of Röntgen Rays for Photographic Purposes. BRUNNER. *Elek. Zeit.*, June 11.—He used influence machines and found that by approaching the hand to the tube the cathode rays are deflected and streams of sparks pass to the hand; in his tubes he therefore used a strip of tinfoil on the outside of the tube, connected to the earth; the illumination in the tube then became stronger and the time of exposure was reduced to a fourth, while the impressions produced were very good; with this device there is greater danger of the tube being pierced by sparks, which is especially the case if the tinfoil does not adhere firmly and smoothly to the glass or has sharp points.

Röntgen Rays. S. P. THOMPSON. Lond. *Elec. Eng.* and *Elec. Rev.*, June 19; a brief abstract of a Physical Society paper.—He describes experiments which he made to obtain some indication of polarization; a large number of crystals were tested, but all the results were negative; all attempts to obtain a true reflection fail, although it appears as if some bodies are capable of giving diffused reflections; he found that if the rays are reflected from a surface of sodium in vacuum the amount reflected is a minimum for normal incidence and increases at oblique incidents; comparing this behavior with that of ultra-violet light, it supports the idea that the rays consist of transverse vibrations.

Principles of Alternating-Current Working. HAY. Lond. *Elec. Eng.*, June 19.—The beginning of a reprint based on a series of lectures at a college; it is elementary in character.

Electric and Magnetic Research at Low Temperatures. FLEMING. Lond. *Elec. Eng.*, June 19; a continuation of his lecture (see *Digest*, last week).—He gives the results in the form of a chart and tables which are reproduced, showing the variation between the specific resistance and the temperature; the lines for the pure metals all converge downward, indicating that the resistance would vanish at the absolute zero, but no such convergence is indicated for the alloys; the slightest impurity in a metal changes the position of these lines; the order of conductivity is different at low than at ordinary temperatures; the lines of some metals are very much curved; the lines of the principal magnetic metals concave upward, which is apparently characteristic of many magnetic alloys; the magnetic metals have smaller atomic volumes than any other metal and, generally speaking, the worst conductors among the metals are those that have the large atomic volumes and large valency; if to one pure metal a small quantity of another is added the result is always to raise the resistance line almost parallel to that of the predominant constituent; when two pure metals are alloyed together in various proportions, there is generally some proportion which has a maximum resistivity; except in the case of alloys of zinc, tin, lead and cadmium with each other, the resistivity is greater than that of either of its constituent metals; in many well-known alloys the proportions which give high if not the highest resistivity are those which correspond to definite and possible chemical combinations of the metals with each other. They made a special study of the resistance of a large series of steel alloys containing various proportions of nickel, aluminum, chromium tungsten and manganese; the table showing the results is not given; a table is given showing the thermo-electromotive force of pure metals and alloys.

Photo-Fluoroscope. BLEYER. *Elec. Eng.*, July 1.—A reprint with illustrations, of a communication to a medical society in Naples. The apparatus consists simply of the usual fluorescent screen with a camera attached to the end of the paper cone which is usually held up to the eyes; the image on the screen becomes that which is photographed; the object can be seen and studied from the outside of the screen (provided the object itself is not placed directly on the screen, which is the best position for obtaining the sharpest image); a dark room is required for good result; the image on the screen is first produced before the plate is uncovered, so as to get the best position; after exposing the plate the X-rays are started and continued for one or two minutes; they are then stopped and the plate removed; "good strong X-rays" are required; a coil giving from six to eight-inch sparks will answer all purposes.

A New Principle in Radiography. ROLLINS. *Elec. Rev.*, July 1.—To show the interior of bones requires such a long exposure that it destroys all trace of structure in some of the several parts; to overcome this he uses a pile of half a dozen or a dozen sensitive plates, exposing them all at the same time one over the other, and giving them sufficient time so that the plate nearest the bulb gives the proper exposure for the least transparent tissues; some substance may be placed between the successive plates that is not very transparent to the rays, so as to produce a greater difference between the plates.

Röntgen-Ray Tubes. SHALLENBERGER. *Amer. Electrician*, June.—He discusses the source of the rays and states that while the rays proceed from the fluorescent spots on the glass in some forms of tubes, this is true only for those that have diffused cathode rays proceeding from an unfocused reflector; referring to the focus tube which he described some time ago, and from which he obtained excellent results, he shows that the platinum plate is the source and that the glass acts only to a very small extent as a source; when this plate is made the anode it becomes much more intense.

Permeability of Metallic Salts and Solutions for X-Rays. SMITH. *West. Elec.*, June 27.—A short article with reproductions of radiographs which were made to find whether the difference of permeability of metals extends also to their salts and the solutions of them; from this he concludes that the permeability of metallic salts or their solutions depend on the positive radical and is proportional to its combining weight.

Shape of Crookes Tubes and Degree of Vacuum for Producing X-Rays. CHAPPIUS. *Elec. Eng.*, June 24.—A translation with the illustrations, of the article abstracted in the *Digest*, June 20. (The authors are *Chaband* and *Hurmuzescu*, not *Chappius*, as stated in this translation.)

ELECTRO-CHEMISTRY AND BATTERIES.

Ozone Generator. OTTO system. Lond. *Elec. Rev.*, June 19; a brief description of the apparatus.—"It consists of a rectangular box of wood, coated internally with varnish, and standing on an insulated foot. The box contains a series of parallel elements, each consisting of two glass plates, having perforations at their one end, and having between them a sheet of aluminum or other conducting material, stopping short of the perforations, which are arranged alternately at the lower end of one element and at the upper end of the next one. The end plates are only provided with one opening for the entry and egress respectively of the gas to be ozonized. The glass plates are separated by thin strips of asbestos, and the end plates rise above the others, the trough-like space thus formed being filled in with suitable cement to seal the box hermetically. The alternate conducting plates are connected to one terminal, while the remaining plates are connected to the other pole of a Rhumkorff coil or high-tension alternating-current generator. The electrical discharge takes place across the spaces between the successive elements, while the current of oxygen to be ozonized flows in a zig-zag course through the apparatus."

Accumulator Jars. *Elek. Zeit.*, June 11.—An illustrated description of glass jars made with recesses on the inside surfaces of two opposite sides, which hold the plates some distance from the bottom and separate them from each other, allowance being made for the expansion of the plates.

Electricity Direct from Carbon. COEHN. *Elec. Eng.*, July 1.—A reprint of an article abstracted in the *Digest*, April 11, under "Carbon Ions."

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Very Large and Very Small Alternating Currents. CAMPBELL. Lond. *Elec. Eng.* and *Elec. Rev.*, June 19; a brief abstract of a Physical Society paper.—He advocated the use of air-core transformers for measurements above or below the range of available instruments; when measuring the primary current by observing the voltage on the open-circuit secondary, the readings are found to depend on the frequency; to overcome this difficulty he used a closed secondary with a very high inductance, when the primary current was found to be proportional to the secondary, which latter may be measured by an ammeter; in a ring transformer with a closed-magnetic circuit, if the load on the secondary consists solely of a 100-ampere balance of very low resistance, the ratio between the primary and secondary currents is practically constant; but with an open-magnetic circuit transformer this is not so, as the ratio varies considerably with the frequency.

Resistance Box. GRIFFITHS. Lond. *Elec. Eng.* and *Elec. Rev.*, June 19.—An abstract of a Physical Society paper, in which he describes his improved form; the abstract contains merely the novel features, among which are, that it permits of the coils being compared with one another without the use of standard coils, and with great ease and rapidity; it is possible to measure up to 105 ohms to within 0.000001 ohm.

Modification of the Wheatstone Bridge. *West. Elec.*, July 4.—An illustrated description of the device described in the *Digest*, June 6 (Lacoine) for increasing the ratio in the usual bridge boxes.

Testing Iron and Steel for Magnetic Quality. *American Electrician*, June.—An abstract with illustrations of the recent paper of Howe (see *Digest*, last week).

TELEGRAPHY, TELEPHONY AND SIGNALS.

Disturbances in Telegraph and Telephone Circuits by Light and Power Currents. STRECKER. Lond. *Elec.*, June 19.—A brief abstract of a recent paper giving some interesting statistics compiled by the German Post Office, covering a period of the last five years. In 1891 there were five cases; in 1892, four; in 1893, two; in 1894, 15; in 1895, 31, and in the first four months of 1896, 19 cases, making a total of 76; the increase in the number can be explained by the increased use of the electric railway; in most cases; it was the telephone circuits that suffered, and in only two cases was there damage reported to telegraph lines; in 61 cases the disturbance was caused by electric railways, and in 15 by lighting plants; in 59 cases the safety devices, such as wooden strips, guard-wires, etc., failed to act; in 40 of the 76 cases the line wire broke and came in contact with the lighting circuit; many disturbances were caused during the fixing of the wires and by broken guard-wires; the damage caused was mostly small, not including two fires; to protect instruments that department uses fuses in the circuit, which consists of a wire 0.07 mm

in diameter, made of a non-oxidizable alloy enclosed in a glass tube sealed at both ends, thus avoiding the formation of an arc; the fusing current is 0.8 ampere; the whole fuse is easily interchanged; another type of fuse consists of a porcelain block with a fuse wire running through the hole; both tubes have given great satisfaction.

Electrical Communication with Lighthouses and Light Vessels. Lond. *Elec. Rev.*, June 19.—An abstract of some length of the recent report of the Royal Commission (see *Digest*, June 27).

Communication with Light Houses and Light Ships. Elec. Eng., July 1.—A reprint in part of the recent report of the Royal Commission (see *Digest*, June 27 ; also above).

Home Telephone Company's System. Elec. Eng., July 1.—An illustrated description of some length of the system devised by Minnis and used in Mobile ; some of the details differ considerably from the apparatus generally in use.

MISCELLANEOUS.

Municipal Electrical Association. Lond. *Elec. Eng.*, June 19; the conclusion of the record of the proceedings (see *Digest*, last week).—A number of the papers are being published in the London electrical journals of June 19; the last paper is abstracted above. The Lond. *Elec. Rev.*, June 19, discusses the objects and scope of the Association in the leading editorial, and reprints a report of the proceedings of the first meeting.

The Kelvin Jubilee.—The Lond. *Elec.*, June 19, contains an article on Lord Kelvin's researches; another on his work in submarine telegraphy, giving descriptions of several of the most important apparatus devised by him in this field; it also publishes an article on the electrical measuring instruments devised by him. An account is given of the jubilee celebration; and the leading editorial is devoted to this topic. The Lond. *Elec. Eng.*, June 19, reprints from the *Scotsman* some details of Lord Kelvin's career; also from the *Times* an article on the electrical inventions of Lord Kelvin. The Lond. *Elec. Rev.*, June 19, publishes some of the most interesting of the congratulatory telegrams received.

Municipal Electrical Association. El'ty, July 1.—A reprint of an abstract of the proceedings of this association (see *Digest* last week), together with abstracts of the papers and the discussions.

Electric Organ in Rochester. West. Elec., July 4.—A brief description of the one just erected in the New York State Industrial School.

Edison Laboratory. Amer. Electrician, June.—A description, accompanied by a number of illustrations.

New Books.

The Alternating-Current Transformer in Theory and Practice. By J. A. Fleming, M.A., D.Sc. (Lond.) F.R.S., etc. Vol. I. The Induction of Electric Currents. New Edition. London : *The Electrician* Printing & Publishing Company, Limited. 1896. 611 pages, 213 illustrations. Price, $5.

This work needs no introduction on the part of the reviewer, since there has perhaps been no single treatise published bearing upon the subject of electricity which has been more highly valued or more universally recognized as a standard than the original volume by Prof. Fleming. It therefore remains to simply draw a comparison between the first and second editions of this standard and classic work. A first glance shows us that the volume has been enlarged by the addition of some 124 pages, and upon a more careful perusal of the contents it will be found that the author has in many cases completely revised the text and that at other places matter has been entirely omitted and other matter substituted. The volume is greatly improved by the addition of new illustrations. Glancing at the preface we find the statement made that the treatise "deals with the subject not as a basis for mathematical gymnastics, but with the object of acquiring practical and useful knowledge." Chapter I, which contains an historical introduction, naturally enough remains but little changed, although the text has been carefully revised. The most important addition made to this chapter is the credit given to early investigations of Joseph Henry. In this connection the author makes the most complimentary statement, "The name of Joseph Henry is one which we must link with that of our own countryman as a co-worker, nay, even an anticipator in some things in the region of fundamental discovery and electromagnetism." Chapter II, which treats of electromagnetic induction has been materially improved and the subject presented in a more clear and logical manner. Several tables have been added giving hysteretic losses in iron and steel. Chapter III, on the theory of simple periodic currents, is the most important in the entire volume and here again some 40 pages have been added and the context changed. Chapter IV has been entirely remodelled and the treatment of the ideal transformer omitted, substituting instead an account of many of the experiments first performed by Prof. Elihu Thomson on electromagnetic repulsion. The most noteworthy omission, perhaps, is the three dynamometer experimental method devised by Ferraris. Chapter V treats of the dynamical theory of current induction. It contains most of the matter which appears in the former edition, and we regret to say that so much of the old matter has been retained. Were we to write a book on the remarkable and classic experiments of Hertz and electromagnetic waves, we should not for one moment think of including a mathematical demonstration on the transformer, and so, were we to write a book on the theory of the transformer, we should certainly not think that the experiments of Hertz were applicable. We can see no justification in including so much of this matter together with Maxwell's theory of molecular vortices, not that it is in itself not valuable, but because such matter belongs more properly to a separate treatise. A sixth chapter has been added which contains entirely new matter and is second only in importance to Chapter III. It treats of the induction coil and the transformer not as an ideal type, but gives experimental curves and is confined to actual conditions. Statements are made, however, which are not made perfectly evident to the reader, such as for instance, that "the reciprocal of the power factor of a transformer on an open secondary circuit is a measure of the reluctance of the transformer.' Other ideas are expressed which give the impression that the author himself is rather shaky in his belief as to their correctness, as for instance in page 583 it is stated that "it is generally true that a sharp peaked E.M.F. curve gives a less hysteresis loss in the iron than does a rounded or sine E.M.F. curve having the same mean square value," whereas, on page 596 he says, "Broadly speaking, pointed or peaked potential curves give rise to greater core loss than rounded or flat primary potential curves." In the second volume the author promises to return to a discussion of these matters and enter into details more fully. We trust that when we come to inspect this treatise we will find at the same time that he has presented his ideas in a more decisive manner. We fail to find in the entire volume the term polyphase used. We regret exceedingly that the author has not considered the subject of polyphase currents of sufficient importance to include a treatment of their theory, and especially of the theory of the methods of measuring such currents. Had he omitted some hundred pages of Chapter V and substituted for this an exposition of polyphase currents the volume would in our estimation have been greatly improved. The work on the whole is to be highly commended, and will be found to be an exceptionally valuable aid to students who wish to become familiar with the theory and practice of the alternate-current transformer.

Press Working of Metals. By Oberlin Smith. John Wiley & Sons, New York. Chapman & Hall, Limited, London. 276 pages, 433 illustrations. Price, $3.

In the preface of this work the author states that there is very little literature upon the subject of which he treats, and that he therefore feels justified in presenting this volume. No attempt is made to treat the subject in an exhaustive manner, and for this reason the work is all that is claimed for it. It contains a great deal of valuable information. An idea of the subjects treated can best be obtained from the chapter headings which follow the introduction. They are : Press Classification and Anatomy, A Museum of Presses, Discs, Materials and Measurements, Cutting Processes, Bending Processes, Curling and Seaming Processes, Drawing Processes, Re-Drawing Processes, Coining Processes, Press Feeding and Miscellaneous. The work is written in an easy style and contains some speculative remarks on the early history of coining and on the making of dies which are of interest to readers in general as showing their possible origin and development, but, however, are not of great value. There is a great deal of practical information in the book pertaining to a wide range of details connected with the subject and the long and varied experience of the author in different branches of press work especially qualifies him for the production of such a book.

New Polyphase Armature.

At a recent meeting of the Elektrotechnischer Verein, of Berlin, Herr Dolivo-Dobrowolsky showed a new type armature for three-phase motors. The armature resembles a compact and massive drum, the surface of which is provided with a large number of small radially cut grooves parallel to the axis. Into these grooves are pressed copper strips, which extend at both ends over the edge of the drum and are there connected to copper rings. Herr Dobrowolsky states that this construction is electrically equal to the old one of the Allgemeine Elektricitäts Gesellschaft, which consisted of laminated iron, through which insulated copper bars are led.

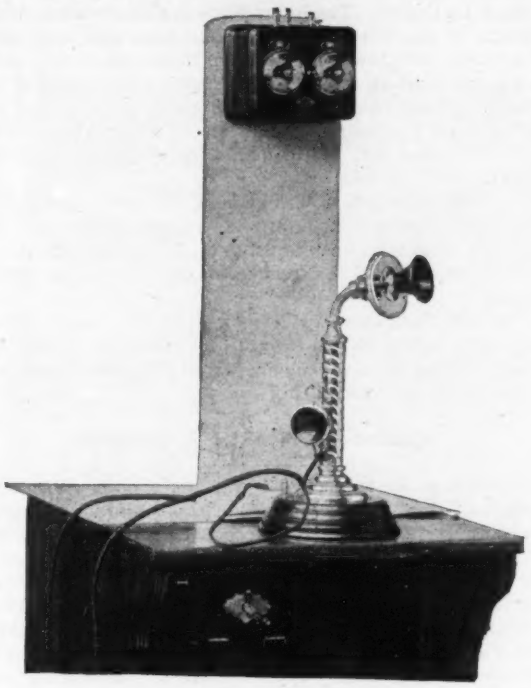
The Standard Telephone & Electric Company.

In the West the telephone apparatus made by the Standard Telephone & Electric Company, Madison, Wis., is said to be meeting with much favor, and giving good satisfaction wherever it has been installed. These telephones have proved their worth by the test of time, which test is infallible in the selection of the worthy from the unworthy.

The company reports that it has equipped over 100 exchanges with its apparatus, and these are stated to be dividend paying, which, of course, is the most important feature of any telephone exchange. Among these exchanges may be mentioned those in the following named places: Portland, Ore., 1500 numbers; San Jose, Cal., 600; Marquette County, Mich., 600; Jacksonville, Fla., 700, and Madison, Wis., 600.

The Milde microphone transmitter manufactured by this company is

said to be a very sensitive instrument; and as powerful as the solid back transmitter. No adjustment is required, and the carbon does not pack and otherwise cause trouble. It is a very compact and simple instrument, and has, we are informed, been adopted by governments, exchanges and railways in Europe, Asia and South America.



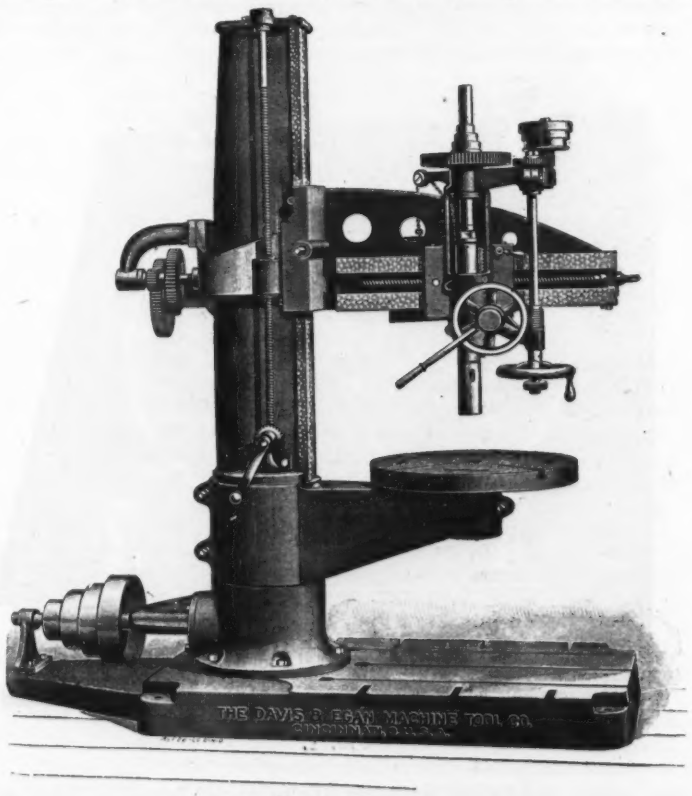
MICROPHONE TRANSMITTER.

The Milde microphone was awarded gold and bronze medals at various European expositions, and received a gold medal at the World's Fair, Chicago.

The Standard Company's system it is claimed meets every requirement of service, the instruments being well made and efficient in operation.

Radial Drill.

The column of the 60-inch radial drill, illustrated herewith, and built by the Davis & Egan Machine Tool Company, of Cincinnati, O., is of the hollow box-girder type, and revolves in anti-friction bearings in the stump, to which it is closely fitted, and which is firmly bolted to the base.



RADIAL DRILL.

The arm carrying the table also revolves about the outside of this same stump, and by a novel arrangement it can be clamped to the stump without clamping the column, or they can all three be clamped rigidly together.

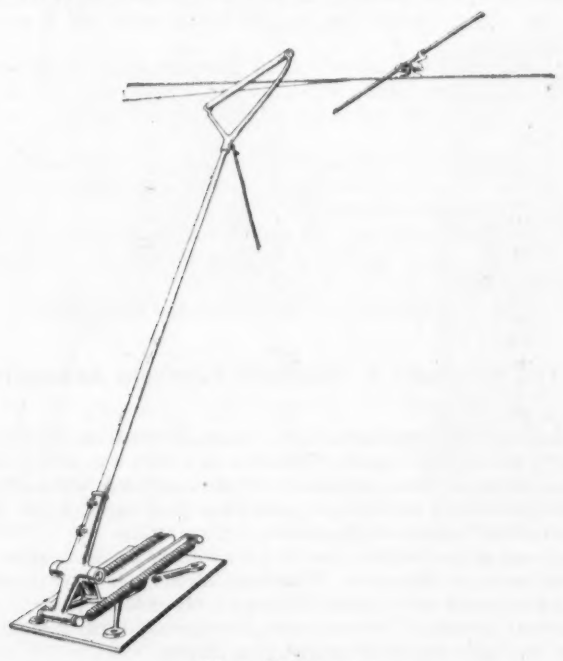
The arm has an unusually long bearing on the planed face of the column, and can be raised or lowered by the screw shown, which is convenient to the hand of the operator. It can be firmly clamped to the face of the column. The head is accurately aligned, and can be moved to any place on the arm by means of the cross screw and firmly clamped. The spindle is made of crucible steel, and is bored for No. 4 Morse taper socket. It is counterbalanced, has power-feed with three changes, and is furnished with a quick return. The feed-belt can be tightened without cutting. The drill is driven by a four-speed cone mounted on double bearings near the base of the column, giving eight changes of speed with the back gears engaged. The base plate is extra heavy, and extends the full length of the arm, with a back extension to support the outer end of the lower cone shaft. It is strongly ribbed, and has ample T-slot for clamping work.

Electric Plows.

Within the last 12 months, says the London *Electrician*, several experiments have been made by German firms to replace animal power by electrical power in agricultural operations. The German Government have now joined the ranks of experimenters, and are carrying out some extensive trials of electric plows at the Sillium estate, near the Upper Hartz. No figures have so far been published. Some information, however, has been furnished by the Union Electrical Company of Berlin, who have also made experiments with an electric plowing apparatus. The power required for this machine was 11 kilowatts when plowing a width of 24 inches and a depth of 14 inches at the rate of 88 yards per minute. The area plowed in a 10 hours' working day at this rate would be 7½ acres. The apparatus is so arranged that parallel to the motor car there runs at the other side of the field a car carrying the other end of a wire rope. The plow is hauled along this rope to and fro, and both cars are slowly moved on. The greatest difficulty seems to lie in the fixing and moving of the pulley car. The pressure employed is 500 volts.

A New Trolley.

The Walker Company has just placed on the market a new trolley which, it is said, avoids the claims of infringement against the Van Depoele patent, and at the same time is of superior merit to the ordinary trolley introduced by these changes. The trolley pole swings on a pivot in a vertical plane, and is forced upward by springs. It has no lateral motion whatever, and therefore can never get out of parallelism with the track. Mounted at the top of the trolley pole is a roller which revolves on ball bearings, and as no oil is used, admits of metal contact between the roller and fork. This roller, which is shown in the accompanying cut, is of hard steel, sheathed with a suitable coating of metal to make the best contact with the trolley wire. The ordinary form of trolley shows the evils due to the use of oil in the trolley bearings. Between the trolley wheel and its axle there is a continuous arcing, and considerable heat is developed, due to the passage of the current. This rapidly carbonizes any oil which may be in between the surfaces finally causing the trolley wheel to stick and skid, and before the car barn is reached it becomes so flattened that it is



NEW TROLLEY.

practically ruined. The roller form, however, has the advantage that it can run over the ordinary switches, while at the same time, as the cut shows, it requires no special switch, the mere junction of the wires being sufficient. This is quite an item in the expense of overhead construction.

The rigid position with regard to lateral motion by no means interferes with the freedom of turning the trolley around when it is necessary. By simply pulling down the trolley arm a suitable mechanism unlatches the support at the base allowing it to be swung around, and when brought to its reversed position latches again. The great merit of this trolley is that it can never come off the wire, and therefore it will probably be largely used for this reason on interurban service where high speeds are attained and where it would be dangerous to have a trolley jump the wire, thereby cutting off the current supply and depriving the motorman of the power of reversing, and at the same time involving the great liability of pulling down the overhead construction. The cross-bow trolley has proved a success, and its property of keeping the wire at all times has been very valuable. The Walker trolley combines the good qualities of the cross bow and the ordinary trolley by enlarging the roller to reduce the peripheral speed. By the device already mentioned it enables the trolley to be easily turned around, and incidentally avoids infringing the Van Depoele patent.

Convenient Electro-Medical Outfit.

The demand for a first-class, low-price electro-medical family outfit led J. Jones & Son, New York, to produce the apparatus illustrated herewith.

As will be seen the coil, switch and coil-terminals are attached to the nner surface of the box lid, so that when the box is opened the

Family Electro-Medical Outfit.

apparatus is at once accessible for use. The simple act of closing the lid covers up everything and protects the apparatus from injury. The lower section of the carrying case contains a cell of dry battery, which obviates the attending inconveniences of a wet cell.

The outfit is portable and very convenient to carry around anywhere. It is, moreover, very compact and light, the dimensions of the box being 7½ inches long, 5 inches deep and 3⅛ inches wide, and it weighs only 3½ pounds.

This outfit, the manufacturers state, possesses all of the good qualities of their "perfection" outfit, which has had a good run. It is simple and well constructed, and can be used by any one without any special instruction.

The dry battery is said to be durable, and the manufacturers guarantee for it a life of from 6 to 12 months, according to frequency of use. When exhausted a new cell is very easily substituted.

With each outfit come two silk conducting cords with tips, two tube hand electrodes, two insulating handles for use with either hand or sponge electrodes.

This outfit is designated by the makers as the "J" Family Medical Battery.

The Minnesota & Wisconsin Telephone Association.

A meeting of the representatives of many of the local telephone companies in Minnesota, Western Wisconsin and Iowa was held at the Hotel Winona, Winona, Minn., on June 15. Those companies which are not represented personally sent letters promising their support and co-operation in the furtherance of the objects of the meeting.

The result of the meeting was the formation of an association entitled the Minnesota & Wisconsin Telephone Association, and the following named gentlemen were elected officers for the ensuing year:

President, James A. Tawney; vice-president, William Lohmiller; secretary, W. Hayes Laird; treasurer, J. A. Malone.

The Minnesota & Wisconsin Telephone Association was formed after the plan of the Iowa independent and Ohio independent associations, and has for its object mutual protection and the development of the interests of all local and co-operative telephone companies in Minnesota, Western Wisconsin and Northern Iowa.

Among the prominent companies forming the association are the Winona Telephone Company and the La Crosse & Southern Telephone Company.

The Winona Telephone Company is now connected with Rochester, Stewartville, Lewiston, Chatfield, Plainview, Altoona, Dover, Fountain City, Rolling Stone, St. Charles, Utica and other points, and expects soon to reach La Crosse. The latter place is already connected with the entire system of the Western Electric Telephone Company, which operates through Northern Iowa and Southern Minnesota, having in use at the present time upward of 1000 telephones and approximately 1200 miles of toll lines. These lines connect various flourishing and important towns throughout the company's district, including Austin, Albert Lea, Waseca, Winnebago City, Blue Earth City, Algona, Britt, Waucoma, Princeton and other places.

The La Crosse & Southern Telephone Company is just about to connect a number of towns with La Crosse, and the Menominee Telephone Company will extend its lines to St. Paul, Minn., and eastward to Eau Claire. From there it will be extended to connect with the Winona Company's system.

The La Crosse Company expect soon to have a line to Winona, and Madison is working up towns toward La Crosse with a view to making connections at that place which will permit of communication throughout the systems above mentioned.

Electro-Therapeutic Apparatus.

One great annoyance to electro-therapeutists is the enormous battery equipment that they are always obliged to maintain. Heretofore the use of lighting currents has been prohibited because they could not be controlled with the accuracy necessary in the treatment of sensitive patients. Messrs. J. C. Vetter & Co., 103 East Twenty-third Street, New York, are introducing a line of goods to supply this need and they are so successful and of sufficient interest to warrant description and illustration. Mr. Vetter has employed the principle of the shunt in all of his apparatus and has ingeniously applied them to perform a great number of offices. This principle briefly is as follows: Connecting across the lighting mains a resistance of a certain amount and connecting one pole of the patient circuit to one of the lighting mains and the other to a movable contact which can touch at various points along this resistance. The voltage to which the patient is subjected may thus be varied from zero to the maximum that the lighting current can produce.

The amount of current necessary for electro-therapeutic work is very small, and absolute control is the great desideratum. Mr. Vetter arranges his volt controller as follows: He has a main resistance, as before stated, which is connected in series with a small auxiliary resistance. This auxiliary resistance is also adjustable, and by means of it the voltage at the terminals of the main resistance is adjusted to 110 volts exactly, in case it proves to be higher than that amount. By swinging the main resistance arm off its contacts, the voltage at the secondary terminals, if such they may be called, will now be in exact unison with the corresponding numbers on the circumference of the circle of resist-

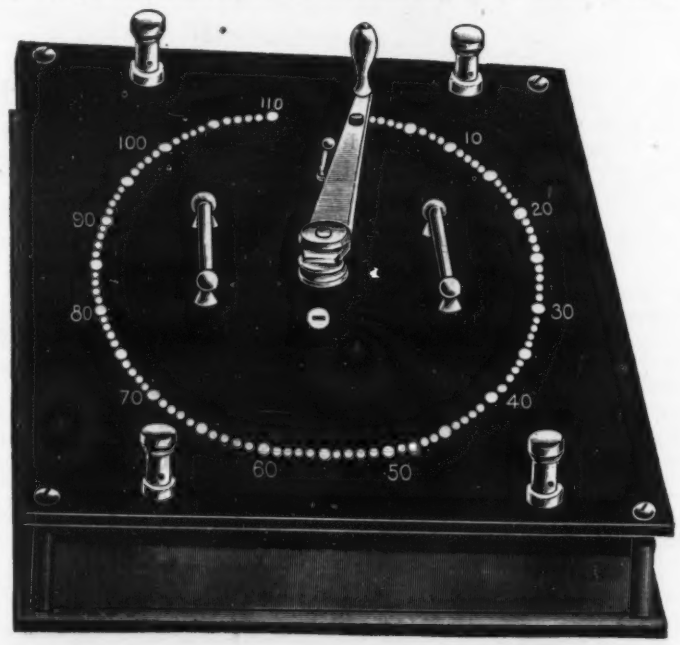


Fig. 1.

ance points. Interposed in this circuit also are two ingenious safety devices, which consist of the ordinary fuse wire, supplemented by a shunt of very high resistance. In ordinary cases, if the fuse should blow, the current would instantly cease and the patient would receive a shock which would be disagreeable, if not dangerous. Such a contingency is, however, impossible, for the reason that in using this device the circuit

is never broken. Two of these devices are placed on either side of the system.

The secondary or patient circuit also has a resistance in series with it, which is called a limit resistance. In many cases this resistance is constant and prevents the flow of more than a certain amount of current, even if the secondary terminals are short-circuited. In some cases it is variable, so that the limit of current may be varied. Any physician will

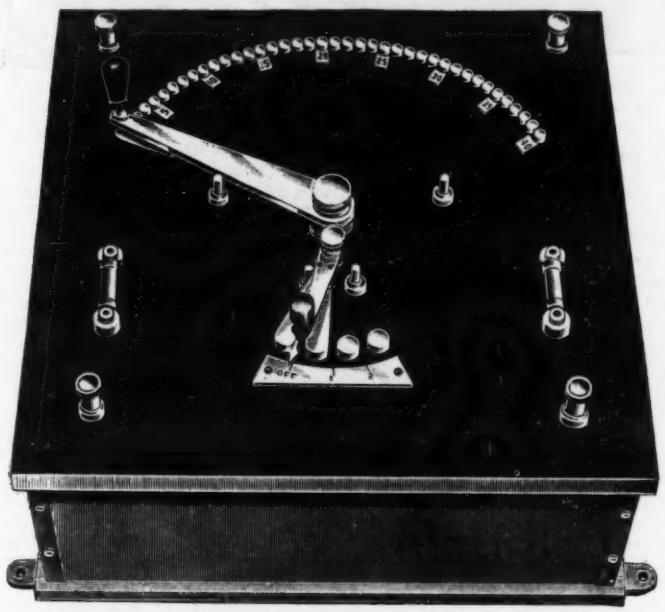


FIG. 2.

at once appreciate the value of obtaining these exact adjustments of current and voltage.

A cut of the volt controller is shown in Fig. 1. Fig. 2 shows the same volt controller designed for electro-cataphoresis, and is merely the ordinary volt controller with a variable limit resistance. In Fig. 3 is shown the cauterizing device. This is a very ingenious arrangement. A shunt composed of rods of carbon is placed across the mains, and is kept at a uniform temperature by a small battery-motor fan, which obtains its dif-

FIG. 3.

ference of potential by connecting to suitable points on the shunt-circuit. Without this motor and fan the carbons would seriously overheat. The cauterizing circuit is connected in shunt with the carbons and is fused to 20 amperes. It is controlled by a spring switch, which in turn is latched by a little electromagnetic lock that may be opened instantly by the pressure of a button which closes the auxiliary circuit. A thermostat in the interior of the apparatus also closes this auxiliary circuit and opens the main circuit, in case the carbons get too hot. This thermostat, it is needless to state, can be set to operate at any temperature desired.

The lighting circuit supplies current to a small lamp requiring about two volts, this lamp being mounted on a suitable handle and suitable for introduction into the mouth or nostrils to illuminate the surface to be cauterized. A button on the cauterizing knife controls the current so that the knife can be inserted while perfectly cool and brought to redness, and after the operation is performed the current is cut off and the knife withdrawn as cool as before. This device is shown in Fig. 3.

Another ingenious specialty consists of a current tap. The ordinary plug connection, it is well known, sacrifices the lamp at which the connection is made. With the Vetter current tap contacts are provided at the side of the socket to take off the current, and the lamp may be placed in the socket on the plug and burn as brilliantly as before. The convenience of this device is obvious, as far as lighting arrangements are concerned. Wherever a 110-volt current is desired the firm supplies what is called the "parallel tap," in which the contacts are merely connected to either side of the 110-volt circuit. For cases where a limited amount of current is desired a supply device called the "series tap" is provided. In this the lamp is directly in series, with the terminals exposed. By using the lamp properly the current may be limited to any desired quantity, from ¼ of an ampere to 4½ amperes on short circuit.

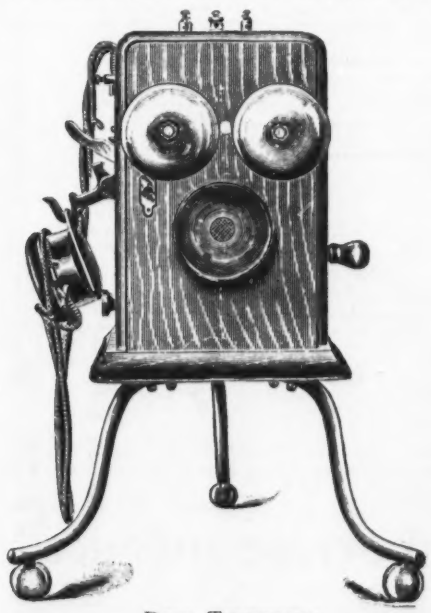
Mr. Vetter also proposes to employ the shunt principle on electric bells and annunciators. By means of it electric bells in elevators and hotels and other similar places may be operated by dynamo currents, thus avoiding the use of batteries. He also manufactures a line of measuring instruments which he will place upon the market.

Improved Telephones.

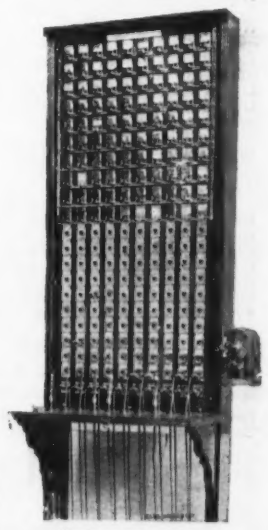
The Harrison Electric Company, 189 La Salle Street, Chicago, Ill., has inaugurated a new feature in its business. It will build exchanges in cities that do not care to erect their own buildings or assume the many responsibilities connected with telephone exchanges. The company's plans provide for erecting the buildings, maintaining them, and liberally dividing the profits with the subscribers.

The telephone of the Harrison Electric Company is said to embody several improvements and special features. It has no infringing shunt circuit to its magneto bell and no infringing solid back transmitter. The automatic hook and push-in crank of the magneto bell are in nowise infringed by the Harrison instrument. The transmitter is said to be a loud talker when properly connected, and is constructed on new and reliable principles. The receiver also embodies new ideas, both electrical and mechanical, and is said to reproduce the original sounds very clearly and distinctly.

The desk telephone made by this company, of which an illustration is given herewith, is claimed to be a very excellent instrument. It is portable and very convenient. The case is solid black walnut, well finished, with mountings of nickel. The illustration of the desk instrument shows



DESK TELEPHONE.



SWITCHBOARD.

very clearly the Harrison hook switch, which is claimed to be the only non-infringing hook made.

The Harrison switchboard is also claimed to be entirely non-infringing, and is the result of over 20 years of study and experiment on the part of the inventor. Every section of 100 numbers includes a transmitter, receiver, induction coil, hand magneto-generator and night-bell attachment. A good idea of the construction and appearance of the Harrison switchboard may be obtained from the accompanying illustration of one section.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, July 3, 1896.

GENERAL ELECTRIC.—Among the electrical stocks none suffered so great a drop during the week as General Electric, the net loss being 4½ on the week's business. The closing price was 26 as against 30½ at the close of the week previous. The lowest point reached last week was 22.

TELEGRAPHS.—Western Union remained comparatively steady throughout the week, closing with a net loss of ¾.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	118¼	
Edison Electric Ill., New York	100	95	97
" " " Brooklyn	100	99	102
" " " Boston	100	135	140
" " " Philadelphia	100	137	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	26½	26¾
Electric Storage, pref	100	28	28½
General Electric	100	26	26⅛
General Electric, pref	100	71	73
Westinghouse Consolidated, com	50	27	28
" " pref	50	50	51

BONDS.

Edison Electric Ill., New York	105	109	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	92½	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	201½	202
American District Telegraph	100	29	39
American Telegraph & Cable	100	91	..
Central & South American Telegraph	100	124	127
Commercial Cables	100	140	160
Erie Telephone	100	59	59½
New England Telephone	100	92	..
Postal Telegraph-Cable	100	83	85½
Western Union Telegraph	100	82¼	82½

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17¾	18
Brooklyn Rapid Transit		21⅝	22¼
Brooklyn Traction	100	..	14
" " pref.	100	46	48
Buffalo St. Ry	100	68	70
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	45	49
Hestonville	100	52	54
" pref.		..	62½
New Orleans Traction	100	12	14
" " pref.	100	55	60
North Shore Traction	100	25	27
" " pref.	100	75	78
Rochester St. Ry	..	..	25
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14½	14¾
West End, Boston	100	67⅛	68½
" " pref.	100	87	88
Worcester Traction	100	15½	17½
" " pref.	100	89	91

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	78½	80
Buffalo St. Ry. 1st con. 5s	100	106	*108
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	93	*97
Rochester St. Ry. 1st 5s	100	99½	*102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—Street railway securities during the past week displayed some irregularity. There was some demand for a few issues, but the general list continued dull and neglected.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, July 6, 1896.

MR. J. S. CRIDER, secretary and manager of the Washington Carbon Company, was in New York last week.

IN NEW QUARTERS.—T. J. Murphy & Co., manufacturers of slate and marble switchboards, etc., have moved their office and factory to 511-513 West Thirteenth Street.

BUSINESS SUSPENDED.—The Dale Manufacturing Company, electrical supply dealers, 108 Greenwich Street, has been closed by the sheriff on an execution for $1690, in favor of the Waterbury Manufacturing Company for goods sold and delivered.

THE EAST RIVER TUNNEL.—The New York Board of Aldermen has granted the application of the New York & Brooklyn Railway Company for the right to tunnel under Ann Street from Park Row to the East River. The company proposes to build a tunnel from Park Row to the City Hall in Brooklyn, through which cars are to be operated by electricity. The proposed tunnel will be 8225 feet in length, and, beginning at Park Row, it will have a gradual descent of four feet in the hundred. The cost is estimated at $6,000,000.

THE BURRY PRINTING TELEGRAPH SYSTEM.—Mr. John Burry, electrician of the Stock Quotation Telegraph Company, New York, has the distinction of being the only exhibitor at the recent electrical exposition, of a practically operating telegraph system. His printing system, which embodies the latest inventions in this particular branch of electrical application, attracted great attention. Mr. Burry uses the storage battery in his system, as the steady current which it gives conduces to more satisfactory operation of the apparatus.

TIFFANY & CO. are completing at Forest Hill, N. J., a new factory, which will be operated entirely by electricity, not a steam-driven machine being employed beyond the limits of the power-house. The present factory and force at 53 Prince Street, New York, will be moved out as soon as the electrical apparatus is installed. The electrical plant will consist of two 125-hp 250-volt General Electric dynamos, which will furnish current to more than 20 motors scattered throughout the building. This will be 300 feet long in front, and will have three wings, each 100 feet long, extending back of the main building. Of these motors some will be attached directly to the machines, and some will drive a number of machines by belts from a shaft. The electrical system of power distribution in the Tiffany factory has been adopted as more economical and desirable than any other known method, and only after careful calculations and comparison with the results obtainable from a distribution of power to shafting by belts from steam engines.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., July 3, 1896.

FALL RIVER, MASS.—The Board of Gas & Electric Light Commissioners has approved the petition of the Fall River Electric Light Company for an increase of capital stock to the amount of $150,000, for the purpose of purchasing the property of the Edison Illuminating Company. This removes the last obstacle in the way of practical consolidation.

FIRE AT THE AMERICAN ELECTRICAL WORKS.—On June 26 a small wooden shed used for storing wire, and a portion of the inside of the drying room of the American Electrical Works at Phillipsdale, Providence, R. I., were destroyed by fire. A lot of wire was damaged by the heat and water. The fire was confined to the drying room, and was extinguished by the employes with their own fire apparatus. Mr. Eugene F. Phillips states that the loss will not exceed $1,000, and is fully covered by insurance.

THE AMERICAN ORDNANCE COMPANY, of Bridgeport, Conn., was organized not long ago for the purpose of manufacturing heavy guns for the Government, and is one of the most important enterprises of its kind in existence. The company has built extensive works, and will use electricity in different ways in connection with gun making. The electric plant of the company will at first consist of 2500 incandescent and 30 arc lights, with motors to the extent of 100 horse-power. Two electric welding machines have been arranged for, but Mr. E. C. Crocker, chief electrician of the company, would be glad to receive catalogues relating to switchboards, wire, cut-outs, incandescent and arc lights, and the other appliances needed for such a plant.

DERBY, CONN.—On March 1, 1896, a very heavy freshet flooded the streets of Derby, Conn., and Superintendent R. W. Foster thus describes the performance of one of his cars: "In order to bring our employees who live on the east side to the car barn so that they could take the cars out on schedule time it was necessary to run the cars across the causeway. This car, equipped with two G. E. 800 motors, had to proceed through water that was 22 inches deep for a distance of 600 feet. After getting them over we continued the operation of this car on regular schedule time for two hours, making eight trips, until we could get one of our old Summer cars to be drawn by horses. At the end of each trip the cars was taken into the barn and carefully examined, the bottom plugs being taken out to allow the water that was in the motors to drain off. This amount was very slight. The power was used on the last notch of the series connections. The wave caused by the motion of the car was sufficient to come up under the bumper and wash across the front platform, so that during one half of each round trip the resistance boxes were practically submerged."

PHILADELPHIA NOTE.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., July 3, 1896.

REMOVAL.—The Edison Electric Light Company, of Philadelphia, has moved its offices to the Heat, Light & Power Building, at the northeast corner of Tenth and Sansom streets.

WASHINGTON NOTES.

WASHINGTON, D. C., July 3, 1896.

THE BALTIMORE & WASHINGTON ELECTRIC RAILWAY.—Work on the Baltimore & Washington railway has been completed between Hyattsville and Laurel, Md., and preparations are being made for the building of the power-house at Lakeland.

EUROPEAN ELECTRIC TRACTION.—Mr. A. N. Connett, chief engineer of the F Street branch of the Metropolitan line, is in receipt of an offer to go o Europe to superintendent the construction of a great system of electric railways in one of the large European cities, but he states that the offer is from a Canadian syndicate, who propose to invest a large sum of money in building railways in Europe. They are after the control of some lines now, and Mr. Connett says that if this is not successful he will not go.

DIVIDEND.—The Chesapeake & Potomac Telephone Company will declare a dividend of $1 per share, payable on July 27, 1896. The company is in difficulty over the regulation against stringing any more overhead wires, as the claim is made against it that it violated the provision by replacing wires. It claims that as long as the mileage is not increased the law is not violated, and further that it can string new wire in any part of the city, providing a corresponding amount of wire is abandoned elsewhere. The question is in the hands of District-Attorney A. A. Thomas, who will render his opinion covering the entire contention.

THE COLUMBIA & MARYLAND ELECTRIC RAILWAY COMPANY has awarded a contract for thirty-two 100-hp motors and twenty 30-hp motors to the Westinghouse Electric Company of Pittsburg, Pa. The larger motors will be used on the through trains between Washington and Baltimore, and the smaller ones between Washington and Laurel, and between Baltimore and Ellicott City. The company has also awarded contracts for a considerable portion of overhead work and poles to be used on the north end of the road to Baltimore parties. It is expected that with the exception of that part of the route between Ellicott City and Laurel the road will be in operation early in August.

ELECTRICITY AT THE CHRISTIAN ENDEAVOR CONVENTION.—One of the features of the great Christian Endeavor convention is the light service in the three big tents, wholly electrical. Each tent will contain 28 arc lights, which will thoroughly light up the immense space. There will be 10 or 12 arc lights put through the grounds also, and on the top of the tents will be red, white and blue lights, the red one being over the platform entrance. Mr. L. D. Bliss, of the Bliss School of Electricity, and a hustling corps of assistants are donating their time and labor to put in place the wire and lights, and will lay 18,000 feet of telephone wire, 10,000 feet of electric light wire, and 2000 feet of bell alarm signal wire for the use of the convention. Instantaneous telephone communication will be established, which will enable the presiding officer in each tent to secure immediate connection with officials in the other tents and also with the committee headquarters in the Washington Light Infantry Armory, and the big Central Hall, a fourth meeting place. A big electric bell will be placed in position on the centre pole of each tent to be used to call the meetings of the convention to order, and a loud electric buzzer will play a unique part in the ceremonies, on account of the immense amount of business to be transacted. Speeches will be strictly limited to a certain time, and if any unwary speaker exceeds his time the buzzer will promptly warn him of the fact. The current will be supplied by the United States Electric Light Company at a cost of $250 for the six days. Messrs. Kennedy and Du Perow are furnishing the lights and material, and are furnishing Tucker automatic telephones.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., July 2, 1896.

DYNAMO WANTED.—Messrs. Rea & Co., pork packers, Pittsburg, Pa., are in the market for a dynamo.

BARGAIN SHEET.—The Charles E. Gregory Company, Chicago, has issued its July list of bargains. The catalogue is very extensive and includes about everything in electrical apparatus and supplies.

OHM'S LAW.—The ingenious little mechanical device gotten out by the Standard Underground Cable Company, Pittsburg, Pa., to remind the busy man of the different forms of Ohm's law, is quite a hit. It is a very handy thing to have about the desk, and saves some mental labor.

THE ELECTRIC APPLIANCE COMPANY has made special arrangements for the manufacture of cross arms for telephone work, *i. e.* an arm 2¼ by 3¾, with holes for 1¼-inch pins. On these goods the Appliance Company is prepared to make specially low prices and prompt shipments.

CHICAGO, ILL.—The Western Telephone Construction Company, Chicago, has contracted to furnish telephone systems for Sandersville, Ga., Maysville, Ky., Cobleskill, N, Y., Hot Springs, S. D., Cape May, N. J., Auburn, Ind,, La Crosse, Wis., and have practically arranged for exchanges at Minneapolis and St. Paul.

MINNEAPOLIS, MINN.—President J. E. Keelyn, of the Western Telephone Construction Company, Chicago, is making arrangements to establish a new telephone exchange in this city. A similar project for St. Paul is under consideration, and between the two cities it is stated that possibly $1,000,000 will be expended for the new service.

THE WASHINGTON CARBON COMPANY, Pittsburg, Pa., has opened a branch office at 205 La Salle Street, Chicago, with D. G. McDougall in charge. This company was formerly represented in Chicago by the Central Electric Company, but owing to the increased demand for these well-known carbons the company deemed it necessary to open an office of its own, whose representative will be enabled to give the business special attention.

ST. LOUIS, MO.—The Council Committee on Public Improvements has reported favorably the Keyes Conduit Bill and there is every prospect that the measure will be passed. The new bill contains all the provisions of the present conduit ordinance, with the addition that the 5 per cent. bond required of the lighting companies from now until 1900 be remitted and the time in which the wires must go underground be limited to December, 1897, instead of 1900.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Kokoma, Ind., manufacturer of "Kokomo-Hunnings" long-distance telephones, switchboards and appliances, is sending to the trade a large sheet illustrating the various classes and styles of instruments and apparatus manufactured by it. The company states that it is in a position, financial and otherwise, to defend its customers in any suits brought against them for alleged infringement of patents owned by the Bell Company or its allies.

OGDEN, UTAH.—The contract for the electrical machinery of the big power plant at this place has been let to the General Electric Company, of Schenectady, N.Y. It is stated that the apparatus will be the largest and the most complete of any in the country except that at the Niagara power plant. The contract calls for 5000 horse-power by Oct. 1 and a line to Salt Lake City capable of transmitting an equal number of horse-power. The plant complete will have 10,000 horse-power. It is stated that the voltage of the plant will be 15,000.

CANADIAN NOTES.

OTTAWA, CANADA, July 3, 1896.

HUDSON'S BAY.—Application is being made to the Dominion Parliament for a charter to construct a steam or electric railway from Fort Churchill, on Hudson's Bay, through the Northwest territories to Calgary.

MONTREAL.—A special meeting of shareholders of the Montreal Park & Island Railway will be held on July 13 to ratify the contract for construction and equipment of new lines and completion of existing lines.

WINNIPEG.—Application is being made to the Dominion Parliament by the Hudson Bay Canal Company with power to build telegraph lines and use electric plant for generating power in connection with the undertaking.

ROSSLAND, B. C.—Application is being made to the Dominion Parliament for a charter to construct telephone and telegraph lines from the town of Trail, B. C., to connect with the Spokane & Columbia system at the International boundary.

HULL, QUEBEC.—The Hull & Aylmer Electric Railway has been formally opened for traffic, the company having leased the tracks of the Canadian Pacific Railroad between these two points for 35 years and connected them into the trolley system.

HAMILTON, ONT.—A charter has been granted the Cataract Power Company, of Hamilton, for the manufacture and sale of electric power, etc. The capital stock is $100,000. The applicants for the charter are Hon. J. M. Gileson, Jas. Dixon, John Moodie, J. W. Sutherland and John Patterson, all of Hamilton, Ont.

TORONTO RADIAL.—Application will be made to Parliament for an act incorporating the Toronto Radial Company with all the powers and privileges heretofore enjoyed by the Toronto Belt Line Railway or any other company operating or having the right to operate an electric railway in the City of Toronto or within 50 miles thereof.

ELECTRIC TRACTION IN ROME.

(From Our Rome Special Correspondent.)

ROME, June 25, 1896.

The municipality of Rome has just passed an ordinance compelling the traction company of that city to substitute electric traction on all the present lines within the next four years, including both the urban and suburban lines. The overhead system will be used on most of the lines, and a conduit or similar underground system will be used in the principal streets of the city. The work of changing has already been begun and will be carried out partly by the Siemens & Halske Electric Company and partly by the General Electric Company.

General News.

NEW INCORPORATIONS.

THE WAYNESBURG, BLUFF & CAMERON TELEPHONE COMPANY has been incorporated at Waynesburg, Pa. The capital stock of the company is $2000.

THE KURTZ NATIONAL TELEPHONE COMPANY, Belleville, Ill., has been formed with a capital stock of $20,000, by William J. Kurtz, Henry R. Beddoe and H. M. Needles.

THE ARCADIA TELEPHONE COMPANY, La Crosse, Wis., has been formed by J. M. Fertig, George A. Schneller, G. N. Hidershide, Emil Maurer and J. C. Gaveney. Capital stock, $5000.

THE UNION ELECTRIC TELEPHONE COMPANY, Sumner, Ia., has been incorporated by J. E. Cass, L. S. Cass, Chester Webster, Thomas Way and T. A. Potter. Capital stock, $100,000.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., has been formed by W. E. Bossert, H. P. Grouse, S. G. Adams and Frank Sang, Utica, N. Y. Capital stock, $16,000.

THE SOUTHERN ELECTRIC COMPANY, Richmond, Va., has been organized by John L. Williams, Edward J. Willis, W. W. Henry, H. L. Cabell and R. L. Williams, Richmond, Va. Capital stock, $500,000.

THE RAHWAY ELECTRIC COMPANY, Rahway, N. J., has been formed by Cassimer W. Boynton, Woodbridge, N. J.; Henry Maurer, New York City; Robert W. de Forest, New York City. Capital stock, $150,000.

THE ST. HELENS LIGHT & WATER COMPANY, St. Helens, Ore., has been incorporated with a capital stock of $9000. Those interested are H. Orchard, Seattle, Wash.; D. J. Switzer, Andrew Kink, St. Helens, Ore.

THE WILLARD ELECTRIC & BATTERY COMPANY, Cleveland, O., has been incorporated by Edwin N. Hawley, Harriet M. Hawley, Charles Suhr, Theodore A. Willard and William N. Morrow. Capital stock, $20,000.

THE TUJUNGA WATER & POWER COMPANY, Los Angeles, Cal., has been organized with a capital stock of $5,000,000, by Samuel Merrill, L. R. Garrett, John W. Craig, Robert N. C. Wilson and M. L. Wicks, Los Angeles.

THE FAIRFAX CONSTRUCTION COMPANY has been incorporated at Alexandria, Va., for the purpose of constructing railways, power plants, etc. The promoters are G. S. Gandy, president, Philadelphia, Pa., and G. L. Boothe. Capital stock, $25,000.

THE NEW YORK ACCUMULATOR & ELECTRIC COMPANY, New York, N. Y., has been incorporated in West Virginia by George W. Harris, Richard J. Holland and William H. Brush, New York City. Capital stock, minimum, $500; maximum, $700,000.

THE EAGLE ELECTRIC WORKS, Peoria, Ill., has been incorporated for the purpose of manufacturing all kinds of electrical machinery. Those interested are Frank Thone, Charles Nash, Peter J. Boerscheidt, Henry Oelkers and Charles J. Sutter. Capital stock, $5,000.

THE FORT SCOTT ELECTRIC LIGHT, HEATING & POWER COMPANY, Fort Scott, Kan., has been incorporated with a capital stock of $100,000. Those interested are C. F. Drake, C. P. Martin, H. L. Page, Charles H. Gardiner and G. D. Perrigo, Fort Scott, Kan.

THE POINT PLEASANT ELECTRIC LIGHT & POWER COMPANY, Point Pleasant, N. J., has been formed by Quimby N. Evans, William C. Adams, Juan A. Almirall, Brooklyn, N. Y.; Joseph H. Johnson, Benjamin F. Coles, Point Pleasant. Capital stock, $10,000.

THE MONTPELIER ELECTRIC LIGHT & WATER COMPANY, Montpelier, Ind., has been incorporated in West Virginia by Jos. Denheimer, Sr., Fort Wayne, Ind.; William C. Shanklin, Frankfort, and George C. Darrow, Montpelier, Ind. Capital stock, minimum, $60,000; maximum, $100,000.

THE SIOUX FALLS TRANSPORTATION COMPANY, Sioux Falls, S. D., has been incorporated with a capital stock of $250,000 for the purpose of building 32 miles of electric railway. The incorporators are Charles F. Smith, John H. Voorhees, Charles O. Bailey and Harold E. Judge, all of Sioux Falls.

THE NEW YORK & QUEENS COUNTY RAILROAD COMPANY, Brooklyn, N. Y., has been incorporated with a capital stock of $2,500,000. The directors are Rudolph T. McCabe, Benjamin Orme, Walter Pease of New York City, and Edward Matthews, Edward T. Stotesbury, Caleb F. Fox, William Shelmerdine and R. E. Cowen, of Philadelphia.

THE ST. LOUIS & BELLEVILLE RAPID TRANSIT COMPANY has been incorporated in St. Louis, Mo., for the purpose of constructing a railway between St. Louis and Belleville. Those interested are George Silsby, Saginaw, Mich., president; G. H. Welton, Chicago, vice-president; and J. H. McDonald, Bay City, secretary. Capital stock, $300,000.

THE LODA ELECTRIC LIGHT, WATER & TELEPHONE COMPANY, Loda, Ill., has been organized with a capital stock of $10,000, for the purpose of building, owning and maintaining an electric lighting plant, water works and telephone lines. The incorporators are E. S. Slocum, J. S. Sheldon, N. L. Kinsman, N. P. Goodell, J. S. West, A. Swanson and F. F. Butzow.

THE TOLEDO TRACTION COMPANY, Toledo, O., has been incorporated for the purpose of operating electric street railways. (Consolidation of the Toledo Traction Company and the Toledo Electric Street Railway Company.) The promoters are Albion E. Lang, president, Toledo, O.; John B. Dennis, vice-president, New York; William E. Hale, treasurer, Chicago; Charles L. Wight, secretary, Toledo, O. Capital stock, $6,000,000.

THE BARNSTABLE COUNTY STREET RAILWAY COMPANY, Barnstable, Mass., has been formed for the purpose of constructing, maintaining and operating a railway with any other motive power than steam. The incorporators are Samuel L. Minot, Willard Howland, Albert D. Bosson, Horace B. Maglathlin, George F. Baker, Boston, Mass.; William B. Bacon, Abel D. Makepeace, William S. Hixon and John Foster. Capital stock, $100,000.

Telegraph and Telephone.

PLUM CITY, WIS.—A telephone line is to be built from this place to Stockholm.

LANCASTER, N. H.—A telephone line is to be established between Lancaster and Camp Willard.

RUSHVILLE CITY, ILL.—The Western Illinois Telephone Company will install a telephone exchange in this place.

GADSDEN, ALA.—Walnut Grove is making great efforts to have a telephone line erected between Gadsden and that place.

LOUISVILLE, KY.—The Ohio Valley Telephone Company has reduced its rates, in order to meet the prices of the Home Telephone Company.

CUMBERLAND, MD.—The Council is considering the question of establishing an electric fire alarm telegraph in the city. It is estimated that 24 boxes will be required.

EAST LIVERPOOL, O.—Work on a new telephone line between East Liverpool and Burgettstown will commence soon. The wires will be strung to Salineville in a short time.

LA CROSSE, WIS.—The La Crosse Telephone Company has purchased a 900-switchboard equipment from the Western Telephone Construction Company. The new Keelyn system of central-office equipment will be used.

PIPESTONE, MINN.—A telephone system is to be introduced in this place, a stock company having been organized for that purpose. The officers are: Oswal l Cass, president; J. R. Carson, treasurer; Max Menzel, secretary.

NEW ALBANY, IND.—The City Council has granted a franchise to the Home Telephone Company to erect poles and string wires in this city. This action on the part of the Council was opposed by the Ohio Valley Telephone Company.

ST. JOSEPH, MO.—The telephone line has been finished to Sheridan and will be completed to Reading, Ia., in a few days. It is the intention of the company to extend a line from Grant City, Mo., to Albany, and from there to St. Joseph.

INDIANAPOLIS, IND.—The Central Union Telephone Company has filed a mortgage for $1,600,000 to cover a 20-year bond for that amount. The money is to be used in extensions and improvements and in placing wires underground in this city.

INDIANAPOLIS, IND.—The Board of Public Works has decided to grant to the Phœnix Telephone Company a franchise under the proper restrictions, if it is satisfied that the company means business and has the money to go on with the enterprise.

CHILLICOTHE, O.—The Central Telephone Company has just opened its new metallic line to Jackson, O. A line will be run through to Richmond Dale and one to Cincinnati. Connections will also be made with Portsmouth, Ironton, Gallipolis and Pomeroy.

RIVER FALLS, WIS.—The citizens of this place are installing a complete system of telephones, which are to be rented for $1 per month. The system will connect every village and city in the county and extensions beyond the county limits are contemplated.

MIDDLETOWN, N. Y.—The stockholders of the Beaverkill Telephone Company have voted to increase their capital stock from $1500 to $4000, and extend their line from Roscoe to Livingston Manor, and from Lew Beach to Margaretville, Delaware County.

MANCHESTER, N. H.—An extension of the telephone underground conduit system is under contemplation. The plan includes an extension as far as Sagamore on North Elm Street and as far as Auburn Street, south on Elm and east on Hanover to Maple Streets.

NEW YORK.—At a special meeting called for the purpose, the stockholders of the American Telephone & Telegraph Company voted to ratify the resolution passed some time ago by the Board of Directors, providing for an increase of the capital stock of the company from $12,000,000 to $20,000,000.

INDIANAPOLIS, IND.—The Board of Public Works is having an ordinance prepared under the city charter to regulate the operation of telephone and telegraph lines. The Board will permit only one trench to be used for the conduit in which the wires are to be placed under ground, and the companies will have to join in the expense.

LA GRANGE, ILL.—The affairs of the La Grange Automatic Telephone Company have been wound up, and the property belonging to it disposed of at a nominal price, reported to be just enough to cover the indebtedness of the company. It is stated that the company has lost money from the first, and the investment which was made in it has proved a total loss, it having been found impossible at the rates charged and the number of telephones in use to pay the operating expenses of the company and keep the plant in order.

MONTREAL, CAN.—On June 30 Justice Davidson dismissed the action of the Bell Telephone Company against the Montreal Street Railway Company. The telephone company sued the railway company for $30,000 damages, asserting that the introduction of the electric trolley car system into Montreal in 1892 caused and has been causing ever since serious derangement of the telephone service, and necessitated the adoption of a number of expensive contrivances to counteract the effect of the presence of the trolley wires.

TORONTO, ONT.—There is a coolness between the Bell Telephone Company and the city officials. Five years ago the company agreed with the city to pay into the city treasury 5 per cent. of its gross rentals for the privilege of operating in Toronto. The agreement expires September next. The company found that its rates were unremunerative and refused to renew the agreement with the city except at slightly increased rates. The city, however, is not disposed to grant the increase and is advertising for a new telephone service. The present service is satisfactory, the only dispute being the one of rates.

NEW WILMINGTON, PA.—The Bell Telephone Company is making extensive improvements in Western Pennsylvania and Eastern Ohio. Several new lines are being erected. Nearly every village is being reached. The competition caused by the erection of systems in Youngstown, O., Beaver Falls, New Castle, Sharon, Mercer and Butler, Pa., has forced rates down quite low and there is rumor of still lower rates to come. In New Castle the Bell Company is placing 'phones in residences for 50 cents per month. The service given for this rate will include 500 'phones and reaches nearly every town in the county. In Mercer County, Pa., the newly organized "local" company has pushed construction very rapidly and is preparing to connect with local companies of the adjoining counties.

KANSAS CITY, MO.—John A. Zellers some time ago brought suit in the Circuit Court to enjoin the Missouri & Kansas Telephone Company from removing the telephone from his place of business. This action was taken after the passage by the City Council of an ordinance reducing the telephone rate to $9 a quarter. Zellers offered that amount to the company, which, however, was refused, the company threatening to remove the telephone unless its rates were paid. Zellers then brought suit to enjoin the company from removing the instrument. In the meantime it was decided in another court that the telephone business in this State came under the head of the interstate law, which the city or legislature could not regulate or interfere with. In view of these circumstances, Zellers decided to dismiss the suit, and it was accordingly so done by the Circuit Court.

Electric Light and Power.

MERCER, PA., is preparing to install an electric lighting plant.

READING, MICH.—Reading is considering the question of electric lights.

HAZLETON, PA.—An electric light plant is to be erected at West Hazleton.

CAPE MAY C. H., N. J.—Cape May Court House is to have public electric lights.

ALGONA, IA.—The City Council is considering plans and estimates for an electric plant.

SAN JOSE, CAL.—The Council is considering the question of putting in an electric light plant.

LARCHMONT, N. Y.—The electors of this village have voted an appropriation for electric lights.

PHILLIPSBURG, N. J.—It is rumored that an electric light plant will shortly be installed in this place.

PLYMOUTH, ILL.—G. Barrien, of Quincy, is seeking to establish an electric lighting plant at Plymouth.

LAURENS, S. C.—The city has voted $30,000 in 6 per cent. bonds for an electric light and water works plant.

WINCHESTER, ILL.—At the meeting of the City Council, Daniel Lawrence was granted a franchise for an electric light plant.

HAWKINSVILLE, GA.—The town will issue $40,000 worth of bonds to have a system of water works, electric lights and sewers.

PORT CLINTON, O.—All arrangements have been made for the installation of an electric light plant in this place within 60 days.

RUSHVILLE. ILL.—The electric light plant in this place has been closed, for the alleged reason that it costs too much money to run it.

JACKSON, TENN.—Arrangements have been made to introduce within the next two or three months electric cars and electric lights.

CINCINNATI, O.—At a meeting of the Board of Aldermen a resolution was passed to erect an electric light in each of the Regan Parks.

EAST PALESTINE, O.—An election will be held to vote on the question of issuing $8000 in bonds for the erection of a lighting plant.

KINGSTON, N. C.—A special election is to be held in this place on the question of issuing bonds to purchase an electric light plant.

GRAND HAVEN, MICH.—On July 20 a vote will be taken on the question of bonding the city for $8,000 for the construction of an electric light plant.

HAZLETON, PA.—The contracts for the erection of the West End Electric Light Company's plant have been awarded. Work will soon be commenced.

DULUTH, MINN.—McCormick Bros., of Duluth, have been awarded a franchise of an electric light plant at Eveleth, Minn. Work on same will begin at once.

LAFAYETTE, COL.—The dynamos and other machinery for the new electric plant have been ordered, and the work of construction will commence at once.

KINGSTON, N. Y.—The Kingston Electric Light Company is putting in a new Fort Wayne compound alternator with a capacity of 3000 incandescent lights.

FLUSHING, L. I.—The Village Association at its last meeting condemned gas as a public illuminant, and declared in favor of an electric-lighting system.

SIDNEY, O.—At the meeting of the Council, the proposition was carried that the clerk be instructed to ascertain the probable cost of a 100-light plant for the town.

SALISBURY, MO.—The electric light plant in this place was destroyed by fire recently, entailing a loss of $11,000. It is supposed that the fire was started by lightning.

CAMDEN, N. J.—The electric fountain in Washington Park is now in operation. It cost $50,000. While the fountain is in play over 6000 gallons of water are pumped up per minute.

FOSSTON, MINN.—The citizens of Fosston concluded to hold an election for the purpose of bonding the village for aid in a scheme to put in an electric light plant and water works.

QUINCY, ILL.—Between now and the middle of August the Quincy Electric Light Company will put in new apparatus that will increase the capacity of the plant more than one third. Engines, boilers and dynamos will be added.

BRYAN, O.—The Village Council has decided to submit to the voters at a special election to be held in about two weeks, the proposition of selling village bonds to the amount of $15,000 for the purpose of purchasing an electric plant for lighting.

BLOOMFIELD, IND.—The citizens of this place want an electric light plant, but are inclined to defer decisive action until the invention of Prof. Jacques and Mr. Edison's new method of producing light by the use of X-rays have been perfected.

COLUMBUS, O.—Last Winter $14,000 was appropriated for the purchase of an electric light plant for the State Capitol. The commission has decided not to construct the plant at present, because the Edison Company has made large reductions in the price of lighting.

BELLEVUE, O.—The Bellevue Light & Power Company is preparing to make extensive improvements at its power-house and on the overhead lines about town. Some $3000 is to be expended. A new 1000-light alternating-current dynamo will be put in the station.

HARTFORD, CONN.—Alderman Child presented a resolution raising a joint special committe of two Aldermen and four Councilmen to act with the Ways and Means Committee and investigate the subject of the city owning and operating an electric lighting plant.

POTTSVILLE, PA.—The Anthracite Electric Light & Power Company, of Pottsville, has sold its franchise and service to a party of gentlemen residents of Pottsville and Tamaqua. One of the conditions of the sale is that the machinery at the other power-house must be removed to some other place within one year.

GRAND RAPIDS, MICH.—The Superior Court has declared invalid the electric light bond issue, for the reason that the city charter does not authorize the Council to bond the city for the purpose of establishing and maintaining an electric lighting plant. The project of establishing a municipal electric lighting plant will therefore be abandoned for the present.

RIVERSIDE, CAL.—The city trustees have adopted a scale of charges for domestic lighting which will impress the Eastern people as rather odd. It is as follows: Dining room, sitting room, hall room and parlor, 40 cents a room each month; kitchen, 25 cents; bedroom, pantry, bathroom, cellar and private stables, 15 cents each; 10 lights for a year, $30; 10 to 15 lights, $37.50; 15 to 20 lights, $40; over 20 lights, $2 each per year. Meter rates, 50 cents per 1000 volt-hours; 5000 to 8000 volts, 10 per cent. off; 8000 to 10,000 volts, 15 per cent, off; 10,000 to 15,000 volts, 20 per cent off. First rate commercial lighting: 16-cp lamps, 1 to 4 lamps, 70 cents a month; 5 to 9 lamps, 60 cents; 10 to 14 lamps, 55 cents; 15 to 20 lamps, 50 cents; 20 to 25 lamps, 45 cents; 25 and over, 40 cents.

THE VIRGINIUS MINES are situated near the summit of Mount Sneffles, Col., in a region of perpetual snow, some 12,700 feet above the level of the sea, or 5000 feet above timber line. They consist of some mines rich enough to repay mining under the most adverse circumstances and of others containing a low grade of ore, which could not be mined profitably without cheap power. This power is derived from the water of the Red Canyon Creek, which is brought through a pipe line 4000 feet long to Pelton wheels, which drive G. E.-bipolar dynamos. The transmission line passes first through dense timber, then over rocks and chasms and heavy snow drifts until it reaches the mine four miles away from the power-house. The current is direct and the voltage 800 volts. The motors drive hoists, pumps, blowers, stamping mills, drills, and an order has recently been given the General Electric Company, which put in the original plant, for an 300-volt two-motor mining locomotive for hauling the silver ore-laden wagons in the mine. Access to the mines in Winter is impossible and in Summer extremely difficult, and before the adoption of electricity the Caroline Mining Company were paying $18 a ton for their fuel—the daily expense of this item amounting to over $100 a day. The amount of power now used is double that formerly supplied by the superseded steam plant, and the saving probably more than repays the cost of the plant every year. Mr. A. E. Reynolds, the manager, recently said: "Probably the most forcible way in which I can explain the advantage of this plant is to state that without it it would be impossible to operate the mines, as our expenses would be prohibitory."

THE ELECTRIC RAILWAY.

PORTCHESTER, N. Y.—The construction of an electric railway in this place is being contemplated.

HACKENSACK, N. J.—The Union Traction Company is securing consents to run a trolley road through Hackensack.

SCRANTON, PA.—The Select Council of this city has decided to recommend the granting of a franchise to the new Citizens' Electric Railway Company.

SPRINGFIELD, MASS.—The Board of Aldermen granted to the Springfield Street Railway Company the right to extend its road to the Longmeadow line.

FLINT, MICH.—Over $12,000 was raised in a single day for the proposed electric road between Flint and Fenton, Mich., by way of Long Lake. Work will begin soon.

MENASHA, WIS.—The ordinance allowing the Neenah & Menasha Street Railway Company to extend its tracks to the city limits was passed by the Common Council.

WILKESBARRE, PA.—It is now possible to travel between this city and Scranton by electric railway for the sum of 30 cents. The ride occupies nearly two hours.

BALTIMORE, MD.—The contract for the building of the Lakeland power house of the Columbia & Maryland Railway has been awarded to Henry Smith & Sons, of this city.

PITTSBURG, PA.—It is reported that a new electric railway is to be built from this city to Butler, and that Brown Bros. & Co., New York bankers, are at the head of the project.

OWASCO, N. Y.—An electric railway is projected at Owasco. The Auburn Company expects to extend the road to Brinkerhoff Point, a distance of seven miles out, and within half a mile of Owasco.

STANDISH, MICH.—An electric road from this place to the Point Lookout summer resort is now one of the probabilities. The route is 20 miles long, taking in Pine River, Arenac and Au Gres villages.

SPRINGFIELD, MASS.—The Enfield & Longmeadow Electric Railway Company has petitioned the Mayor and Aldermen of Springfield for leave to lay tracks through some of the streets of the city.

SPENCER, MASS.—The Warren, Brookfield & Spencer Electric Railway is now open for regular traffic. The cars make the trip between Spencer and West Brookfield in one hour and run on 40 minutes headway.

MANCHESTER, CONN.—The extension of the Hartford, Manchester & Rockville Electric Railway, from Manchester to Tallcotville, was opened for traffic on July 1. This road, it is stated, is the longest in the State.

WILKINSBURG, PA.—At the next meeting of the Wilkinsburg Council that body will be asked to give the right of way over several of the borough streets to the new Wilkinsburg & East Pittsburg Electric Railway.

HAGERSTOWN, MD.—The Council by a vote of three to two, passed an ordinance granting the street railway company a franchise on South Jonathan Street, and giving them Fair Ground Avenue instead of Broadway.

RICHMOND, VA.—The Richmond Traction Company has opened its line in the western part of the city. A trial trip was made by the officers of the company and invited guests. The system is said to work very smoothly.

ALBANY, N. Y.—At the meeting of the Watervliet trustees, the Albany Railway, as lessee of the Watervliet Turnpike & Railway Company, applied for a franchise to lay tracks from the northern boundary of the City of Watervliet.

BROOKVILLE, PA.—The Brookville Railroad Company, with a capital of $130,000, has applied for a charter for the purpose of building a railway from Brookville up the North Fork, 13 miles, to a large timber tract in Polk Township.

ASBURY PARK, N. J.—On July 16 the stockholders of the Seashore Electric Railway Company will vote upon a resolution authorizing the lease of the property and franchises of that company to the Atlantic Coast Electric Railway Company.

WEST SENECA, N. Y.—A franchise was granted the Woodlawn Beach Street Railway Company to extend its line along the Ridge Road to the terminus of the Bailey Avenue street car line, belonging to the Buffalo Street Railway Company.

TRENTON, N. J.—In the case of Aaron Vanderveer against the Asbury Park & Belmar Railway Company, Judge Green appointed the Hon. William L. Dayton, of this city, receiver for the defendant company, and fixed the amount of his bond at $10,000.

PORT JERVIS, N. Y.—The contract for the building of the Port Jervis & Stroudsburg Electric Railway has been given to the Southern Construction Company, of Philadelphia. It is expected that the road will be finished as far as Milford by July 15.

NORTH ADAMS, MASS.—The North Adams Light Company has made arrangements with the Pittsfield Railroad Company to light the Hoosac Tunnel. Extensive alterations will be made in the railroad company's plant in order to meet the requirements of the new contract.

McKEESPORT, PA.—It is proposed to place a special mail car on the Second Avenue electric railway line to carry the mail to 13 different towns, including besides this city East McKeesport, Wilmerding, Turtle Creek, East Pittsburg, Braddock, Rankin, Glenwood, Dravosburg and Reynoldton.

"LONDON: HOW TO SEE IT FROM THE STREET CARS."—This is the title of a neat little book issued by the London Street Railway Company, London, Canada. The title explains the purpose of the book, which is very fully illustrated with views of the most interesting points in the city.

ALBANY, N. Y.—The State Railway Commission has granted the application of the Kingston & Lake Katrine Railway Company for permission to construct an electric railway from Kingston to Lake Katrine. The Syracuse Rapid Transit Railway Company was refused permission to build this road.

COLUMBUS, O.—It is stated that there is a project on foot in this city to build an electric railway from Columbus eastward to the Ohio River. Two routes are under consideration, one terminating on the Ohio side of the river at Bridgeport, which is opposite Wheeling, and the other ending at Steubenville, O.

DOYLESTOWN, PA.—The last property owner along the Doylestown and Willow Grove turnpike, who stood in the way of the trolley line about to be built by the Bucks County Railway Company, has signed the contract for the right of way, and all obstacles to the immediate construction of the road have therefore been removed.

BUFFALO, N. Y.—The members of the Aldermanic Committee on Streets voted to grant to the Buffalo Railway Company permission to lay tracks and run cars in Clinton Street from Bailey Avenue to the city line, in Jefferson Street from Ferry to Main, in Hertel Avenue from Elmwood Avenue to Tonawanda Street and other streets.

NEWARK, N. J.—It is reported that the Bergen Traction Company, the Northern New Jersey Construction Company, and the Union Traction Company will be consolidated, and that the trolley system will be extended to connect with the Newark system. The consolidated lines will unite Newark and Hackensack with Fort Lee, Englewood and Park Ridge.

LONG BRANCH, N. J.—There is a prospect of another trolley war in this city. An application is now before the Board of Commissioners for a franchise and at a previous meeting two other applications for franchises were filed. Hearings will be given on July 16 and 24, and it is understood that bitter opposition will be urged against the granting of two of these franchises.

NEW HAVEN, CONN.—The Springfield, (Mass.) Railway Company will extend its lines southward to Connecticut to meet a line running northward from Enfield, Conn. Another company has been incorporated to build a line between the two points, paralleling the Springfield Company's road. The rival companies will be given a hearing before the Mayor and Aldermen of Springfield in a couple of weeks.

FITCHBURG, MASS.—There is a possibility that this city may be connected with Worcester by a street railway in the near future. A company in Worcester contemplates building a road from that city to Lake Wachusett. F. S. Coolidge, of this city, and a man from Leominster, were in consultation with Westminster parties regarding a road from Waite's Corner to Gardner, with a branch track from Westminster to Lake Wachusett.

BROOKLYN, N. Y.—The Thomson-Houston Electric Company recently brought suit against some of the Brooklyn electric roads for alleged infringement of trolley patents. The suit against the Nassau Electric Railway Company was stricken from the calendar, for the reason that a stipulation had been entered into whereby the Nassau Company promised to pay $20,000 for the appliances now in use and $100 each for all others it may use. According to another stipulation, the suit against the Union Railway Company was temporarily withdrawn.

BROOKLYN, N. Y.—A measure has been introduced in the Board of Aldermen requesting the Board to appoint a special committee of five, whose duty it shall be to inquire into the cause of the recent accidents and shall ascertain if there be any automatic speed regulators and a device for stopping the car, in case of accident to the brake. The committee should recommend to the Board such ordinances as in its judgment will secure to the people of Brooklyn better and safer trolley facilities than are at present given by the various railroad companies of Brooklyn.

WATERVILLE, ME.—It is said that another important electric railway deal is on foot. The Railroad Commissioners will be asked to grant a charter for an electric railway from Skowhegan to Waterville, through Pishon's Ferry, Good Will and Shawmut to Fairfield, where undoubtedly a connection will be made with the Waterville and Fairfield Railway, Light & Power Company, who now hold a charter for a line from Waterville through Vassalboro to the Augusta line. The Commissioners will be asked to grant a charter at once, and it is probable that the road will be built in the course of a year.

ELECTRIC RAILWAY IN VERSAILLES.—Versailles, France, is to have an electric street railway and within two months the old horse cars will give way to the new system. The street railway will be run from the light and power station. The steam generating plant will consist of four semitubular boilers supplying steam to four horizontal single-cylinder engines aggregating 350 horse-power for the light and power service in the city and two steam engines aggregating 240 horse-power for the street railway. The electric generating plant will consist of two General Electric monocyclic machines aggregating 250 kilowatts and two direct-coupled railway generators of same make aggregating 200 kilowatts. The rolling stock will be 15 cars, each equipped with G. E.-800 motors and controllers. The installation will be carried out for the Société Versaillaise de Tramways et de distribution d' Energie Electricque by the Cie Francaise Thomson-Houston of Paris.

BOSTON, MASS.—At a recent session of the Massachusetts Supreme Court Judge Dunbar entered a decision in the case of the New York, New Haven & Hartford Railroad Company against the Hingham & Nantasket Electric Railway Company, confirming the report of the Railroad Commissioners as to the manner in which the defendant railway shall cross the tracks of the plaintiff railway at Rockland Street, Weir River, and near the Nantasket House, at Hull. Both roads are overhead electric roads at these points, and this is the first time the question has come up as to the manner in which it shall be most feasible that such roads shall cross each other without infringing each other's rights. The commissioners found that the continuity of the trolley of the plaintiff railway should not be broken and that it shall remain as it is. The defendant shall construct a swinging arm on either side of the plaintiff's railway and when it shall have occasion to cross, the arm shall be swung so as to give it a continuous trolley to get safely across. As soon as the car has passed the arm shall be swung back again.

BROOKLYN, N. Y.—A dead-letter law, which provides that trolley cars cannot be overcrowded, has been recently unearthed, and is likely to make the local trolley companies considerable trouble. It reads as follows: "No railway companies operating cars by electricity upon any of the streets, avenues or public places in the City of Brooklyn for the purpose of carrying passengers, shall carry more than 50 per cent. more than its seating capacity." The above is Section 4 of an ordinance passed by the Board of Aldermen on April 1, 1895. The above section is printed for the guidance of the police commissioners and other city officials, whose duty it is to enforce it. There have been a number of accidents, which have been attributed to the overcrowding of trolley cars, and the ordinance has been called to the attention of the police, and will probably be enforced. It may cause considerable trouble and annoyance to the trolley companies, and perhaps even more to the riding public. Abroad an American citizen is indignant if a car passes him and refuses to stop at his signal. Passengers are willing to crowd onto a car which is already laden to its utmost capacity, rather than wait for the next one. It is possible, therefore, that the public will dislike the enforcement of the law as much as the trolley companies, and especially will this be the case if no extra cars are run on the lines.

CHICAGO, ILL.—Judge Grosscup has granted an injunction on the petition of the owner of the land from Thirty-seventh Street to Thirty-ninth Street on Fifth Avenue, against the General Electric Railway Company, in the construction of its lines. It was charged by the petitioner that her name was forged on the consent, and the General Electric Railway Company's attorneys, it is stated, did not deny the charge. Other names, it is alleged, were forged. In his decision the judge says: "The use of the street for extraordinary purposes is only lawful to those who have lawful power to so designate it. I am fully alive to the considerations that where the city has a reasonable color of right to grant the additional use, and acts fairly under that color, it would be against public policy to permit every private individual incidentally affected to question such right in the courts. But has the City Council, in the case under consideration, a reasonable color of right to vote this extraordinary use? Certainly not, if there was no petition at all. What is there in a forged petition that makes it one atom better than no petition at all? It is no petition in the contemplation of law. It is no petition in any sense except in the criminal intentions it carries. There is, therefore, no more public authority for this extraordinary use than there would be for the unauthorized excavation of a canal. I do not overlook the contention," said the judge in conclusion, "that the Council is the exclusive judge of the genuineness of the petition. But it is to me inconceivable that the Legislature strictly limited the Council's power to cases where there exists this condition of consent and then made them the exclusive judges of the fact of such consent. The act was intended to restrain the municipality from giving up streets to uses to which the majority of the abutting owners were opposed, but such restraint is empty, if the party restrained is the sole judge of the propriety of its exercise. The act was intended as security to the abutting property-owners as against either the mistakes or injustices of the municipality, and, as such, was not left dependent for its enforcement upon the caprice of one of the parties to whom it applied. In this, as in other cases where the City Council oversteps its rights and thereby trenches upon the property rights of the citizen, it is amendable to the ordinary process and determination of the courts. "I have disagreed from the Palmer case in the Appellate Court for this district, but am in harmony, in that disagreement, with the views of Judges Tuley and Horton of the Circuit bench, and Judge Shepard of the Appellate bench." The Palmer case referred to by Judge Grosscup was that of Potter Palmer and other owners of Wabash avenue, against the construction of the elevated railroad, wherein the court held that the City Council was the judge of the genuineness of the petition and in which the property-owners were said to have redress by damage suit against the road if damage was done by the structure to the abutting property.

PERSONAL NOTE.

DR. FREDERICK BEDELL, of Cornell University, Ithaca, N. Y., was on July 1 married to Miss Mary Louise Crehore, of Cleveland, O. The ceremony was performed in St. George's Church, London, England.

Trade and Industrial Notes.

HAMERSCHLAG & CO., manufacturers of electric specialties and novelties, 26 Liberty Street, New York, are now placing a new dynamo and motor brush on the market which is said to possess several new features. It is a leaf brush, made of high and low resistance metal, and is claimed topossess all the advantages of gauze. copper and carbon brushes, low resistance for carrying capacity and high resistance to break up cross currents, thus preventing short-circuiting in adjacent section of the commutator

STEEL BOILER-HOUSE.—The Seymour Manufacturing Company, Seymour, Conn., is enlarging its boiler-house, and the new portion of the building will be constructed entirely of steel in order to make it absolutely fireproof. The contract for the steel work has been let to the Berlin Iron Bridge Company, East Berlin, Conn.

PIONEER ARC LAMP.—A great many of the orders recently taken by the Electric Arc Light Company, New York, came on account of the fact that for two or three weeks at a time the same pair of carbons keep their life, and the annoyances resulting from carbon dust and the daily visits of the trimmer are obviated. The Electric Arc Light Company states that it has sold ahead between three and four thousand "Pioneer" lamps.

DIPLOMAS AND MEDALS RECEIVED.—The E. W. Bliss Company, Brooklyn, N. Y., has received the diplomas and medals which were awarded to it and the Stiles & Parker Press Company (owned by the E. W. Bliss Company) for their exhibits at the World's Fair in 1893. The award to the E. W. Bliss Company was for toggle drawing presses, adjustable power presses, gang slitters and seaming machine. The award to the Stiles & Parker Press Company was for punching presses and drop-hammers "of good design, first-class construction, accuracy in operation and high efficiency of performance."

IDEAL ENGINES.—Among the recent shipments of Ideal engines by the Harrisburg Foundry & Machine Company, Harrisburg, Pa., are the following: One 45-hp Ideal engine direct-connected to a Fort Wayne generator, for the County Commissioners of New Bedford, Mass.: one 30-hp Ideal engine direct-connected to a Siemens & Halske generator, to the Scranton Electric Construction Company, Scranton, Pa.; two 350-hp engines for railway service—one belted and the other direct-connected to General Electric generators—to the Braintree & Weymouth Railway Company, East Braintree, Mass.; one 300-hp Ideal engine, to the Akron & Cuyahoga Rapid Transit Company, Akron, O.; one 300-hp tandem-compound and one 70-hp Ideal engine, both direct-connected to General Electric generators, for James Pyle & Sons, New York City; two 70-hp Ideal engines direct-connected to 40-kw Eddy generators for the Cook Apartment House, New York City; three 100-hp Ideal engines, direct-connected to Siemens & Halske generators, to the Hotel La Rochelle, New York City; one 45-hp Ideal engine direct-connected to Crocker-Wheeler generator, for the College of Physicians and Surgeons, New York City; two 40-hp Ideal engines direct-connected to Westinghouse generators, for E. Robinson's Sons, Reading, Pa.; one 160-hp Ideal engine for railway service to the Maryland Manufacturing & Construction Company, Baltimore, Md. All of the above were sold through the New York agents, Messrs. W. R. Fleming & Co.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company, 67–71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 30, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building. New York.]

552,796. ELECTRIC RAILWAY; H. Brandenburg, Chicago, Ill. App. filed March 11, 1895. In an electric railway the combination with the conduit having integral substantially parallel upwardly-extending webs, of removable angle-irons secured to the outer sides of said webs with their horizontal portions projecting toward each other and slightly separated to form a slot, and of said angle-irons having a flange for the wheel formed integral therewith and projecting outside of the web.

562,806. CONDUIT FOR ELECTRICAL CONDUCTORS; J. F. Cumings, Detroit, Mich. App. filed March 4, 1895. A conduit for electrical conductors consisting of an outer metal casing and an inner insulating lining, comprising two like sections of fibrous material, suitably treated to render the same impervious to moisture, and each formed with interlocking meeting edges.

562,808. MEANS FOR PROTECTING UNDERGROUND ELECTRICAL CONDUCTORS; F. Davis and R. E. B. Crompton, London, England. App. filed April 11. 1893. An underground conduit for electrical conductors having polygonal channels, dividing walls of uniform substance of metal, and a spigot and socket-joint, the spigot having a recurved lip and also having an angle at the entrance of each way into the spigot ends as well as the socket ends rounded off to prevent any sharp edges being offered to oppose the passage of the cable.

562,850. ELECTRIC GAS LIGHTING APPARATUS; F. O. Plummer, Worcester, Mass. App. filed Aug. 16, 1886. In an electrical gas lighting apparatus the combination of an incandescent gas burner, a bushing supporting and insulating gas burner, a check-nut threaded onto the shank of said burner and adapted to connect a lighting wire thereto, platinum terminals located on the inside of the burner-hood, one of said terminals being rigidly fastened in sockets formed in the burner-cap, an operating-rod for the other terminal, an insulating bearing for said rod, a lighter magnet connected to turn on the gas and actuate said rod, and a shut-off magnet arranged to cut off the supply of gas.

562,864. DYNAMO-ELECTRIC MACHINE; N. W. Storer, Wilkinsburg, Pa. App. filed Oct. 2, 1895. An electric generator or motor having field-magnet pole-pieces, the extreme edges of tips of which are provided with slots or grooves extending transversely to the armature axis.

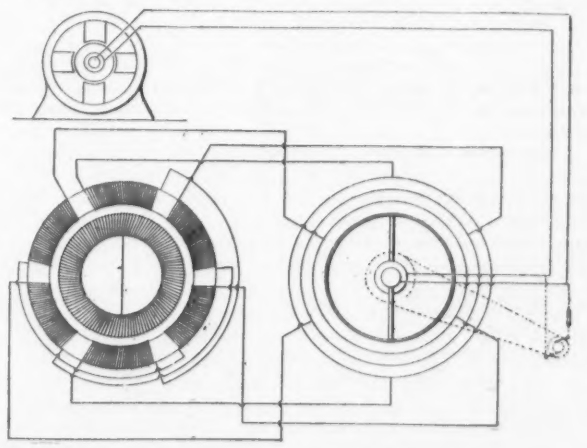
562,868. DYNAMO-ELECTRIC MACHINE; C. C. and H. B. Warren, Chicago, Ill. App. filed Jan. 31, 1896. In a dynamo-electric machine, the combination of a stationary and a rotatable element of magnetic material constituting a field-core in the form of a hollow ring or annulus, armature coils disposed upon said core with a magnetizing-coil secured within the interior of said ring or annulus, and a shelf projecting from the interior wall of said hollow ring or annulus adapted to support said magnetizing coil and upon which said coil may be readily placed as a whole.

562,890. ELECTRIC RAILWAY; B. Ford, Johnstown, Pa. App. filed Aug. 30, 1895. In an electric railway the combination of a conductor extending along the railway and divided into sections, electromagnetic switches for successively bringing into circuit the said sections, a car, a motor on the car for propelling it receiving current from the sectional conductor, a battery on the car for temporarily energizing the electromagnetic switches, and a variable counter E. M. F. generator in series with the battery, and in parallel with the motor to protect the battery from the line current and abnormal discharge.

562,891. ELECTRIC HAND LIGHTING GAS BURNER; G. J. Galbraith, Boston, Mass. App. filed April 18, 1896. In an electric hand lighting gas burner, the combination of a plate having an arm, a spring, a pin, a toothed edge cam upon the edge of which the pin is moved vertically and means for vibrating the same.

562,894. ELECTRIC RAILWAY; W. E. Hanshue, Kalamazoo, Mich. App. filed Jan. 27, 1894. In an electrical railway a conduit composed of a tubular casting of cast iron, with a longitudinal opening at the top; a porcelain lining for said conduit extending out over the upper edges of the opening at the top and thickened at the centre of the bottom to form a base, and a copper bar extending the length of the conduit and supported on the thickened base or porcelain at the bottom.

562,904. TROLLEY WHEEL; I. B. Metzger, Canton, O. App. filed June 20, 1895. The combination with a trolley wheel having a chamber, of a hub secured within said chamber and provided with a chamber having apertures, one of which communicates with the trolley chamber and the other of which is adapted to supply oil to the trolley spindle. a valve for controlling the flow of oil from the trolley wheel chamber to the hub-chamber, and a connection between the valve and the trolley for retaining the valve in a predetermined regulated position.



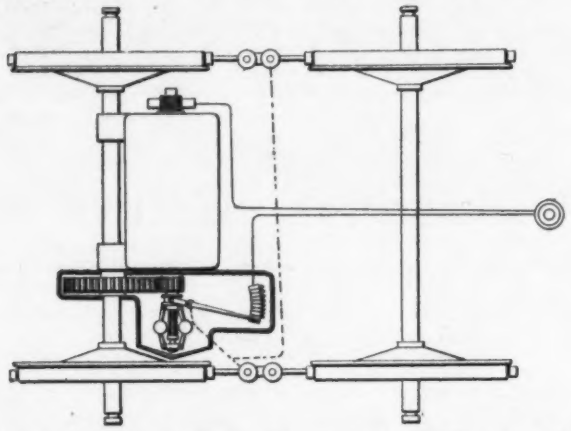
562,924.—SYSTEM OF ELECTRICAL DISTRIBUTION.

562,906. SIGNALING APPARATUS FOR TELEPHONE LINES; F. R. McBerty, Downer's Grove, Ill. App. filed Oct. 29, 1895. The combination with a telephone line having a switch at its sub-station controlling the continuity of the line, and a signaling instrument and source of current in the line, of a subsidiary bridge or return circuit of the line between the signaling instrument and the sub-station, and means for controlling the continuity of the bridge from the sub-station.

562,917. THERMOSTAT; C. B. Rogers, Stevenson, Md. App. filed April 1, 1896. A thermostat or circuit-controller consisting of a pair of supports, a shaft mounted on knife-edge pivots therein, a thermometer-tube adjustably mounted on said shaft, a circuit-closing arm secured to the outer end of said shaft, an indicating dial provided with a series of perforations, contact points adapted to be inserted in said perforations within the path of movement of said circuit-closing arm, and a pair of electric circuits, both including an electric battery, a motor and said circuit-closing arm.

562,924. SYSTEM OF ELECTRICAL DISTRIBUTION; G. J. Scott, Philadelphia, Pa. App. filed Jan. 3, 1896. In combination, a primary or inducing ring or member included in a single-phase alternating-current circuit, a secondary ring or member in inductive relation to said primary member, a circuit having its terminals connected to opposite points of said secondary member, and means for mechanically moving the points of greatest difference of potential in said secondary member.

562,925. AUTOMATIC SPEED CONTROLLER FOR ELECTRIC CARS; H. A. Seymour, Washington, D. C. App. filed May 19, 1896 In an electrically propelled car, the combination with electrically actuated brake mechanism and a speed governor, of means governed and controlled by the speed governor for automatically actuating and gradually applying the brake whenever the car attains a speed in excess of a pre-determined maximum rate of speed.



562,925.—Automatic Speed Controller for Electric Cars.

562,929. ELECTRIC SIGNAL; C. H. Sherwood, Utica, N. Y. App. filed Oct. 21, 1895. In an electric signaling system, the combination of a bell, a normally open electric circuit, bell ringing mechanism and a battery in said circuit, an air cylinder, a circuit maker and breaker consisting of two flexible plates secured on and extending from the end of said cylinder and insulated therefrom, the piston rod of said cylinder moving and pressing said plates into contact in its outward movement to close the circuit, and air pumps and relief-valves communicating with opposite ends of the interior of said cylinder controlling the movement of its piston rod.

562,937. ELECTRIC HAND LIGHTING GAS BURNER; H. C. Thomson, Boston, Mass. App. filed April 18, 1896. In an electric hand-lighting gas burner, the combination with a burner pillar and fixed electrode, of an annular toothed cam, stops, collar, spring-electrode, electrode pin and means for moving the same.

562,972. TROLLEY; C. E. Powell, Bryn Mawr, Pa. App. filed Sept. 19, 1895. In a trolley, the combination with standards, of hinge-couplings at their upper and lower ends, the connecting rods and plate, and the trolley carried on said plate, and the anti-friction rollers at the upper ends of said standards.

562,980. CUT-OUT FOR ELECTRIC CIRCUITS; G. W. Scovil and E. F. Gooding, Elgin, Ill. App. filed Aug. 27, 1895. The combination with a plug, having a central aperture and an annular recess at its lower end, a screw-threaded stem fitting said aperture and projecting from the plug, a plate connected to the upper end of the stem and carrying a binding screw, an annular contact ring seated in the recess and having a binding screw and a fusible strip, the ends of which are wrapped around said binding screws.

563,016. ELECTRODE FOR GALVANIC BELTS; E. S. Collicott, London, England. App. filed May 18, 1896. An electric body-belt or like appliance to be worn next the skin, having two or more reticulated plates of aluminum or other metal which does not injuriously affect the skin, the said plates being connected by wires to the two poles of a pocket electric battery.

563,025. ELECTRIC SIGNALING APPARATUS; M. du Perow, Washington, D. C. App. filed Aug. 3, 1895. A magneto generator, an electric motor, connecting driving mechanism, a broken motor-circuit, a switch for closing said circuit, and a telephone switch hook for actuating said switch in combination with the telephone signaling and speaking circuit.

563,032. ELECTRIC HEATER; W. S. Hadaway, Jr., New York, N. Y. App. filed Feb. 27, 1896. In an electrical heating apparatus the combination of a heat radiating surface, and an electrical conductor in the form of a graduated helix in spiral form upon said radiating surface, but insulated therefrom.

563,033. AUTOMATIC ALARM FOR POSTAL CHUTES; T. F. Hagerty, Woburn, Mass. App. filed Jan. 21, 1896. The combination with a wall provided with a mailing-opening, of a downwardly inclined and extended table leading into a mail receptacle, a poised table mounted therein and normally inclined substantially in alignment with said downwardly inclined table, an upwardly extended resilient, electrical contact fixed in said receptacle adjacent to the forward lower end of said poised table, said contact having sufficient rigidity to support said table when suppressed under normal loads but yielding to abnormal loads, and suitable electrical signaling apparatus connected with said contact and operated by the depression of said poised table into engagement with said supporting contact.

563,073. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filled June 12, 1895. The combination with a telephone line provided with a switch adapted to interrupt the circuit and a source of current in the line, a portion of the line being divided into two parallel branches, of a signal lamp in one of the branches, a resistance coil in the other branch, and a source of current n one of the branches, the polarity of said last mentioned source of current being adapted to oppose the passage of the signaling-current through the lamp and its E. M. F. being sufficient to prevent illumination of the lamp by current in the signaling-circuit.

563,084. TELEPHONE SYSTEM; J. G. Smith, New York, N. Y. App. filed Aug. 6, 1894. A circuit-closing mechanism comprising a bar having a contact, an armature-lever and magnet arranged to operate said bar, a lever or dog to sustain said bar, means for releasing said lever or dog from said bar, projections carried by said lever or dog, and clips to engage and hold said projections to retain the lever or dog in either position it is placed by the sliding bar.

563,094. ELECTRIC RAILWAY; J. Tatham, Philadelphia, Pa. App. filed Sept. 1, 1891. The combination of a slotted conduit consisting of an outer slotted tubular casing, an inner and correspondingly slotted tubular conductor, a mass of insulating material interposed between the two, and bars or plates embracing the edges of the outer casing, inner conductor, and interposed layer of insulating material at each side of the slot, said bars or plates being insulated from the outer casing.

563,119. AMALGAMATOR; F. B. Austin, Tempe, Ariz. T. App. filed June 4, 1895. The combination with a sluice having an opening therein, of a pan arranged in said opening and having inwardly extending and horizontal flanges at its sides, a cover-plate resting on said flanges, the plate being insulated from the pan, spikes respectively projecting from the plate and pan, and means for electrically charging said plate and pan.

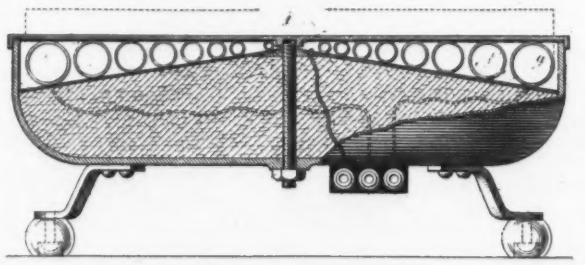
563,127 GALVANIC BATTERY; E. S. Boynton, Brooklyn, N. Y. App. filed Feb. 21, 1895. In a galvanic battery, the combination with a receptacle for the liquid electrolyte, and a frame mounted removably on said receptacle; corresponding electrodes supported in pendant position by said frame, cup-like electrodes encircling each of said pendant-supported electrodes, the outer electrodes being arranged and held in immediate juxtaposition by an insulating medium or bond, and which are removably mounted on said receptacle by means of vertically connecting insulated screw-threaded tubes that are in open relation with the cells thus formed and the receptacle containing the electrolyte.

563,138. DOUBLE-ACTING THERMOSTAT; H. Cortland, Toledo, O. App. filed June 3, 1895. A thermostat comprising a frame, a convex-flexible diaphragm secured therein, conducting fingers secured to the frame and insulated therefrom and operated by the diaphragm, the opposite ends of the fingers extending over the opposite side of the frame, and a contact-screw secured directly in the frame beneath the ends of the fingers.

563,148. TELEGRAPH ALPHABET; S. V. Essick, Yonkers, N. Y. App. filed Sept. 16, 1895. A telegraphic alphabet for transmission of impulses successively alternating in polarity, in which each letter is represented by a single impulse and determined by the length of the impulse, independent of its polarity.

563,149. TELEGRAPHY; S. V. Essick, Yonkers, N. Y. App. filed Sept. 27, 1895. In telegraphy, the means of transmitting and receiving characters, which consists in means for causing impulses successively alternating in polarity in the line, each alternation of which represents a complete letter, the letters being determined by the time between the successive alternations, combined with a receiver controlled by such successive impulses, and adapted to record a letter for each alternate impulse, which letters are determined by their relative lengths

563,203. FIRE ALARM; J. R. McCoy, Marshalltown, Ia. App. filed July 10, 1895. In a fire alarm system, the combination with an alarm mechanism, and leads in connection therewith, the leads being under tension, of fusible couplings arranged at intervals in the leads and comprising detachable members connected respectively to the contiguous ends of adjoining sections of a lead, and each member being provided with parallel arms, the parallel arms of one member having a sliding connection with the arms of the interlocking member, and fusible solder or cement for securing the arms in their normal positions.



563,032.—Electric Heater.

563,244 ELECTRIC RAILWAY TROLLEY SYSTEM; W. C. Keithly, San Francisco, Cal. App. filed Oct. 22, 1895. In an electric railway trolley system, having an underground conducting wire, the combination of the conducting wire having perforated lugs securely fastened thereto at intervals, with detachable hangers, the ends of which enter the perforations in said lugs in divergent directions, and having a connection between the said hanger ends to allow such entrance in the said lug, suitable fastenings to secure the break in the said connection, a spring bearing for said connection to relieve the strain on the trolley, and a guide to control the movement of the hangers.

563,245. TELEPHONE SWITCHBOARD SYSTEM; C. E. Scribner, Chicago, Ill. App. filed Nov. 4, 1895. The combination with a telephone line, of a local storage battery in the line circuit at a sub-station, a source of charging current at the central station, a relay controlling the connection of the said source of current with the line, a local circuit including the electromagnet of the relay, and switch-contacts adapted to complete the local circuit in establishing connection with the line.